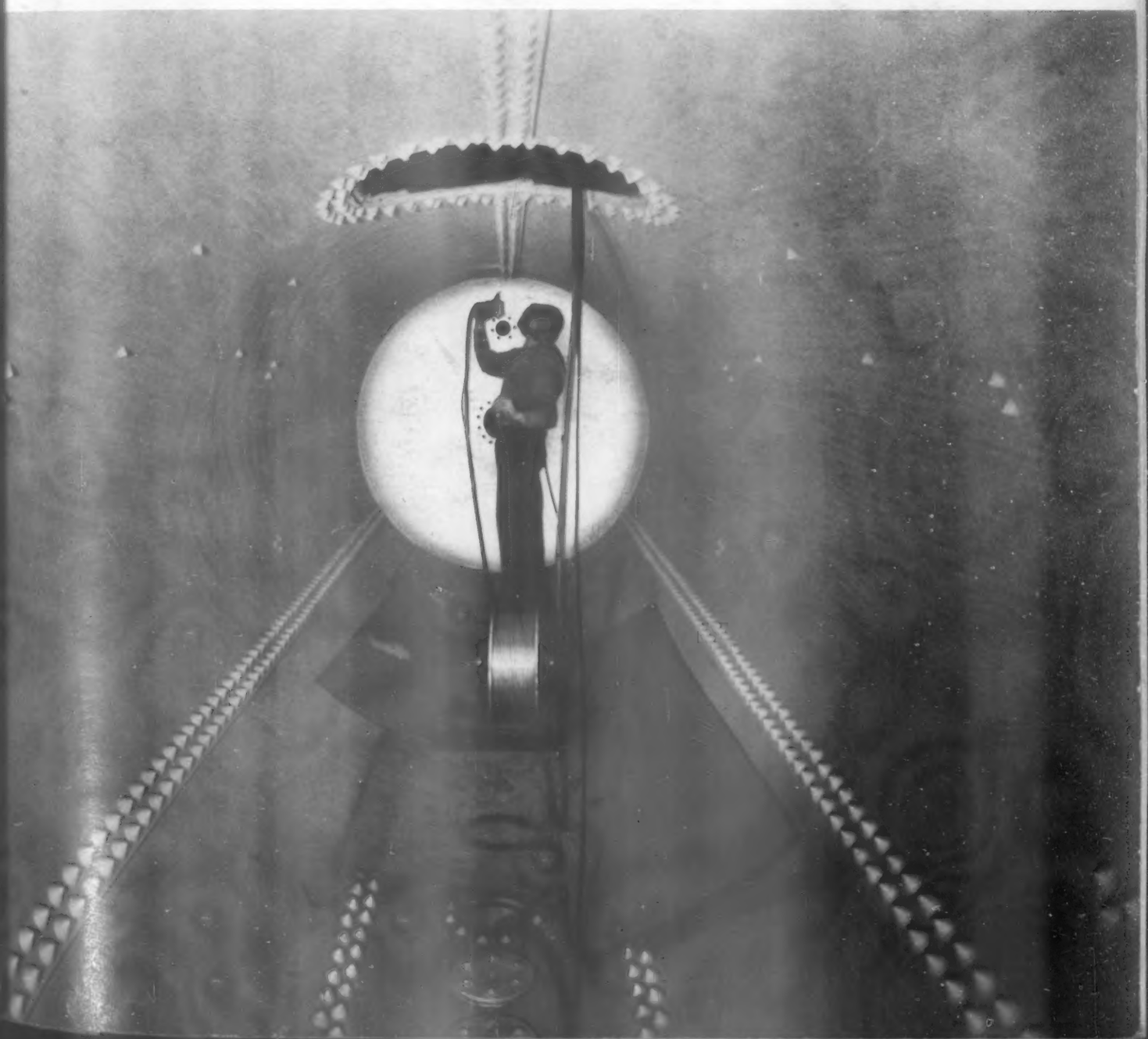
EER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

e XXI

August, 1936

Number 8

SPRAYING inside surface of standard tank car with aluminum to thickness of 0.009 in., to prevent discoloration and iron contamination of the product carried in the car. Work done by the John Nooter Boiler Works Co., St. Louis, Mo.



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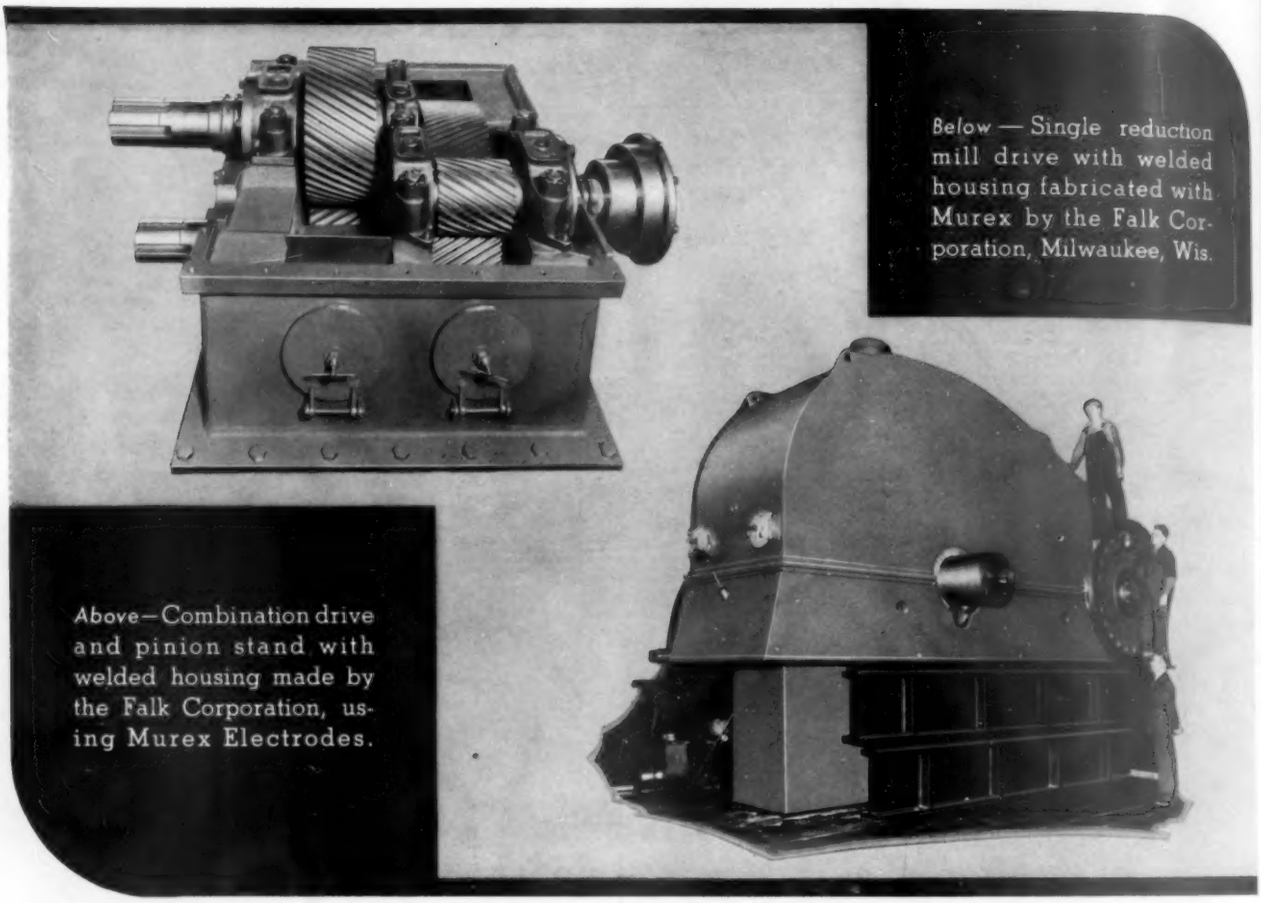

Below — Single reduction mill drive with welded housing fabricated with Murex by the Falk Corporation, Milwaukee, Wis.

Above—Combination drive and pinion stand with welded housing made by the Falk Corporation, using Murex Electrodes.

Welding the housings of heavy gear drives provides strong, light, good-looking units. Fabrication of these housings by welding together rolled plates and steel castings also results in speedier production and economy of materials.

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THE WELDING ENGINEER

Vol. 21, No. 8 AUGUST, 1936

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EDITORIAL

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Beauty and Strength in Design

● In many lines, a new conception of beauty and dignity is becoming apparent. Already, the conventional railroad train with standard coaches and sleepers is beginning to look somewhat old-fashioned. Pratt and Warren trusses, with their horizontal and diagonal lines, are not in repute with bridge builders to the extent that they used to be. Revolutionary ideas have been injected into building and house architecture; although some loud complaints at first were heard, some of these conceptions have been accepted by the public at large and will probably remain with us for many generations.

Municipalities and industrial establishments are turning thumbs down on the elevated water tank that looks like a huge sky-rocket set on top of four slanting legs of steel. In past years, that type of tank was built in hundreds of towns and cities throughout the country, and on the grounds of many industrial plants that prided themselves in their progressiveness and contributions to civic welfare.

Today, however, while such tanks still fulfill their function, they are losing much of their appeal (if they ever had any to speak of) in favor of designs that please the eye of the townspeople and of the fleeting visitors.

Such changes do not mean that people are acquiring a new sense of esthetic values, though that may be true to some extent, but they are chiefly the result of experimentation and aggressiveness on the part of builders and erectors, who are continually finding new ways of improving appearance and perhaps at the same time cutting costs of such structures.

In this connection, one might not be far wrong to say that without fusion welding and gas cutting, we would still be enjoying (if that is the word) the old standards.

For welding and cutting have broken the bonds binding the designer to the straight lines of the drafting board; they have opened the way for a further development of form, made possible by unlimited surface continuity, unmarred by lines of rivets that must be located by engineering precepts rather than by esthetic considerations; they have made possible the elimination of bulky and unsightly gussets; they alone have been the solution of the making of solid designs from plate with contours following smoothly the lines of stress.

In all this development, the principles involved were not new, but it only remained for the practical applications of welding and cutting to give them life.

When the advantage of unbroken contours was realized, and the new lines of plate structures were appreciated, the idea grew rapidly.

So, the designer has had to show his worth as an architect and metallurgist, as well as engineer.

And the end of this development has not yet arrived; at least, new forms and designs continue to make their appearance in the automobile and truck field, in elevated tanks and other vessels, and in machine bases and other parts.

Who knows but that when welding begins to be universally applied to building and bridge construction, it may usher in a renaissance of beauty and strength of design for such structures, just as it has in the case of the automobile, the pasenger train, and the elevated tank?

Speaking of

BLIZZARDS

by NICK RODDER

● If this isn't the ice cream season, I'm an Eskimo, which nobody has ever suggested in my hearing. And speaking of ice cream, that reminds me of a job I get called out on one day last winter. But maybe I better start at the beginning:

One morning — in February — I'm late getting down to the office on account of I have to shovel my way out of the house due to a blizzard which hits overnight. And so when I shows up and the Boss says, "Nick, how'd you like to work on some ice cream cabinets?" I has it all figured out I'm due for a dressing down.

So there wasn't anybody more surprised than I am when I find myself in a factory where the shop crew is working overtime on ice cream cabinets for this summer's trade. This company decides to catch up with the procession so it turns over production to cabinets with Monel Metal tops.

Monel Metal section of present roof on Pennsylvania Railroad Station. This was installed about 1909 and is still in perfect condition.

These ice cream cabinet tops are only single sheets of Monel punched with about 12" diameter holes and the edges then turned down about 1¼". The only welding required on these is the short corner weld on each of the four corners on each cabinet top.

A simple jig, as shown in the attached sketch, was used to keep the edges in line and make for easy welding. You will note that the jig itself is merely a piece of steel angle with the sharp heel filed off and the outside clamps are merely flats or can be steel angle. To make the action of the jig more convenient, in some shops, a cam arrangement is used instead of the C clamps shown.

We use Inco gas welding and brazing flux in the form of a thin paste and paint it on the inside and outside of the corner to be gas welded. The reason for the flux being used is to avoid discoloration as much as possible which makes finishing easier.

A jig is used to minimize buckling and the corner of the jig is filed off so that a bead or fillet of weld metal can come through and so obtain a reinforcement of the corner to withstand the sharp knocks and bumps of the heavy ice cream cans. The corner gas weld is easily finished with a fine file or with electric grinding and finishing equipment.

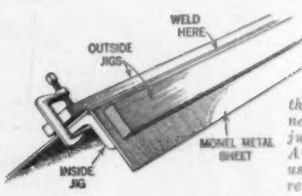
I turn tinkers' helper

I don't know anything can make a roofer madder than to be called a tinker, unless it's a *tink!* Yet I learn my trade when I'm 'prentice backing up rivets with a five-pound dolly and so I guess I got a right to the name. Well this job I'm about to tell of is a roofing job.

A big building had its present metal roof leaking badly after being laid some 25 years. Twenty-five years may be a long while to have your mother-in-law with you, but you want the roof to stay with you for life. They tell me that soft coal soot, when wet during every rain, develops a kind of acid that eats right into the metal. A Monel Metal roof nearby had been standing up O.K. in the same atmosphere for 28 years, and engineers and metallurgists who have inspected this Monel Metal roof report that it will last as long as the building itself. So the owners decide to replace the old roof with Monel Metal.

As on other sheet metal roofings soft solder is the most convenient means of sealing previously locked joints. I'm called to talk over the soft soldering of the Monel and to work out the best method for obtaining the strongest possible joints.

Before lock seaming or joining the edges of Monel sheet, it should be tinned—preferably with an iron rather than with a torch. After seaming or joining the solder can be sweated through very easily. Either high or low tin or 50-50 solder is satisfactory. Any of the regular zinc-chloride base fluxes such as those which are made by killing muriatic acid with zinc will work O.K.



Jig for corner weld. Note that sharp corner of angle iron removed and that inside corners of sheet are just touching. Angles can be used instead of rectangular bars.

You can also get good results with most of the prepared fluxes. Sufficient heat must be carried with the soldering iron to insure complete sweating through of the solder. If necessary the iron should be worked along the seam a little more slowly to allow for the solder to penetrate fully.

Several lap joints were made up following the procedure indicated above and also making up the joint in which the edges had not previously been tinned. It was a simple matter to tear the improperly made joint apart, but very difficult to pull apart the properly tinned and soft soldered and sweated Monel joint. Made the right way that roof is ready for blizzards for 200 years.

Nick Rodder
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** "Cromalloy" Gas Welding Flux is recommended for Inconel.
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

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The Welding Engineer

VOLUME XXI AUGUST, 1936 NUMBER 8

Hints on Maintenance of Resistance Welding Machines . . .

By A. M. MACFARLAND
Consulting Engineer.

SATISFACTORY operation of resistance-welding machines, whether they be spot welders, butt welders, projection welders, or flash welders, depends upon proper maintenance of the working parts.

We shall consider first the simplest type of spot welder, which is the foot-operated machine, having a pair of heavy copper contacts, operated directly or indirectly by the pedal connections.

The successful operation of these machines depends largely upon the skill and judgment of the operator. Once a job is set up and satisfactory welds are being made, the continued operation depends on maintenance of the operating parts in good order. The following items call for special care and attention:

Area of Electrode Points Most Important Factor of Operation

Electrode points should be kept in original shape and diameter. Generally the copper points are tapered, and a small amount of filing will increase the diameter of the tips. The *area* of the contact point is the important factor, and if the point is filed away until the area is doubled, there will be trouble, unless the current is also readjusted.

If the cooling water is too far from the tip, the points may overheat, and flash and stick and cause trouble. In welding plated or galvanized or alloy stock, special attention must be given to keeping the points clean. Special metals are available for points adapted to such work.

It is important that the cooling water be carried down to the tip of the points, with a continuous, free circulation. Otherwise, overheating and sparking and sticking of the points may result.

In the simple form of foot-operated machines, it is necessary to keep the copper contacts clean and the contacting surface in good condition. The contacts should be adjusted with consideration as to time of contact, pressure, etc.

The motor-driven type of machine usually employs a contact operated by a cam, which energizes the hold-in coil of the main contactor. This primary contact must be kept clean, and free from lost motion, so that it will make its contact at the same part of the revolution each time. If this contact is in order, the hold-in coil will be energized at the same instant in each revolution.

Whether the contactor will respond and close promptly, depends upon the adjustment of the contactor parts. These contactors are usually adjustable as to how far they will open; but if the opening is too great, or the spring too strong, there may be a delay in closing.

When we recall that the pull of a magnet decreases with the square of the distance or gap, it will be apparent that the action will be quicker if the contactor is not allowed to open too far.

Switch Contact Surfaces Must Be Kept in Good Condition

The condition of the contact surfaces in the contactor or switch is also important. If the copper is scaled or pitted, there will be some delay in establishing current flow, and heating and sparking will quickly make matters worse. Also, it often happens that such conditions will cause the contactor to stick and fail to open promptly. When this happens, the weld may be overheated or burned. If the contactor is overloaded, this may happen frequently. The cure is to keep the contacts clean and fitted together fairly, or use a larger contactor with heavier copper.

Where a number of machines are connected to one feed line, and several of them are taking current at one time, there will be a drop in voltage sufficient to cause bad welds.

The load on the line should not be great enough to cause a voltage drop of more than 5% under the worst conditions. The line transformer back of the welding machines should have a capacity 1/3 greater than the total capacity of welding transformers that may be loaded at one time.

Various Causes Affect Working of Butt-Welding Machine

As regards butt-welding machines, once a set-up is made and working satisfactorily, any failures or troubles that develop will naturally be due to some variable in the apparatus or operation. The condition of the dies or clamps is important. A film of scale or dirt may act as insulation against the low voltage employed. The fit of the contacting ends may affect the result, by causing uneven heating. Sometimes a variation in the metal analysis is responsible. A new lot of steel may call for some readjustment of current or timing.

The metal pieces being welded may have a film of dried oil or dirt which insulates against good electrical contact in the dies or clamps.

Sometimes the clamps become worn, so that they only make contact on a portion of the surface. Sometimes the pieces being welded will slip in the dies, and avoid full welding pressure. Varia-

tions in line voltage are a frequent source of trouble. Where sheets are being welded, care must be taken to keep good contact at all points between the clamps and the sheet surface.

Where sheets are being welded, care must be taken to keep good contact at all points between the clamps and the sheet surface.

Sometimes sheets are rolled with thin spots, which cause trouble with contacts. Also the sheets may contain bad spots.

Projection Welding Implies Proper Current Distribution

In projection welding, one of the problems is to obtain and maintain an equal distribution of welding current among the several spots.

In the first place, there must be ample transformer capacity for welding the number of spots on the job. Projection spots will require about 50% more capacity than the same spots on flat work.

The die or welding plate must be designed to maintain pressure on all the spots and also to supply current to all of them. Sometimes copper shunts or feeder bars may be connected to outlying parts of the die, to feed current more directly to the remote parts.

Frequently the die is mounted with a toggle action, to allow it to adjust itself evenly. In such case, provision must be made for good electrical connections.

Flash Welding Requires Good Fit Between Work and Dies

In flash welding, one of the principal sources of trouble is the failure of the piece being welded to fit the die or clamp that holds it.

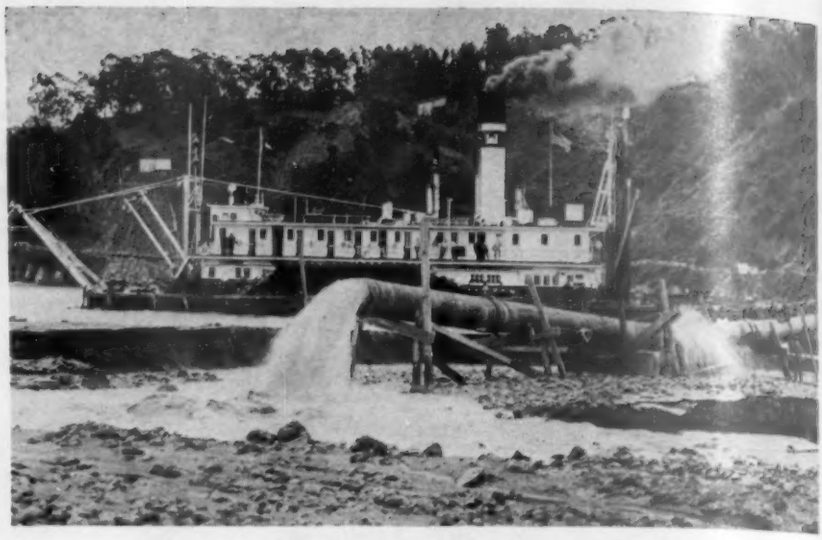
Either the pieces vary in shape or contour, or in condition of the surface, or the dies become worn and make a poor contact at some part. This results in a concentration of current at one side or point and an uneven heating of the ends.

Insufficient transformer capacity may produce the same result by supplying a current flow along the lines of least resistance, with not so much in the corners. Failure of the dies to grip the piece firmly, allowing it to slip when pressure is applied, is another cause of trouble.

A considerable increase in the carbon content of the steel may require a readjustment of the timing of the flash, to avoid brittleness in the weld. More heat stored in the weld will lengthen the time of cooling and provide a slight annealing action.

Welding Used in Work on Exposition Site

In the maintenance and repair of the large amount of electrically welded pipe and buoys and other equipment for the large fleet of United States Army dredgers now filling in the 430-acre site for the $25,000,000 San Francisco International Exposition, to be held in 1939, a special barge is maintained on which is complete welding equipment which is ready 24 hours a day to make practically any weld or repair on the electric welded pipe, buoys and other equipment on the fleet of dredgers, which include the suction dredges *Sacramento, San Joaquin* and *Multnomah;* and the hopper-type dredges *San Pablo* and *Culebra,* all United States Army Engineers equipment.



Welded Steel Pipe Filling In for San Francisco Exposition.
(The big dredge in the background maintains complete 24-hour welding service on thousands of feet of pipe.)

The *Sacramento* began operations on Feb. 11, using approximately 800 ft. of electrically welded pipe, 20 in. in diameter. Additional lengths have been added until at the present time the dredge is pumping sand and water through more than 1,200 ft. of pipe, in filling in the expositions site. This dredge carries approximately 2,000 ft. of electrically welded pipe, the extra 800 ft. being carried on barges ready to be installed in the pipe line by the crawler-type tractor, which tows as many as five lengths on a sled over the sand that has been filled in.

The pipe used on the filled in area are supported on wooden timbers, but the pipe used to connect the filled-in areas with the dredge are supported on pontoons consisting of steel cylinders 30 in. in diameter, electrically welded. There are some 50 of these pontoons which support the pipe sections. Rubber connections between the pipe sections permit the pipe to be moved and adjusted to the various conditions as the dredger moves from side to side and as it advances forward.

Long Beach, California Gets Welding School

A new school for welding instruction recently opened for business at 17th and Orange Aves., Long Beach, Calif., under the name of the Pacific Coast Welding School. The school is owned and operated by the joint partners, L. C. Dotson and J. J. Leach, both of whom have had many years' experience in the welding industry. Both also for a time were associated with the Standard Dredging Co. in the Hawaiian Islands. In the courses of instruction, special attention will be given to shielded-arc welding. Oxyacetylene instruction will also be given.

Bethlehem Engaged in Building Welded Tanks

The Bethlehem Steel Company is erecting a large number of all-welded tanks for various oil companies throughout the Eastern part of the United States at the present time.

Among the jobs, now in process of erection, are five lap-welded tanks for the Pure Oil Co., two of these being of 55,000 barrels capacity, two of 10,000 barrels capacity and one 25,000 barrels.

Another erection job is that of three welded roofs on oil tanks which are being constructed for the Tidewater Oil Co. at Portland, Maine, and four similar jobs at Rensselaer, N. Y. The shells and bottoms of these tanks are riveted but the tops are welded to prevent any leakage that might develop.

Another interesting erection job is being completed for the Frontier Fuel Oil Corp., of Buffalo, N. Y., at their Harriet, N. Y., station, where Bethlehem engineers and welders are busy erecting a large molasses tank having a capacity of 1,000,000 gallons. The shell of this tank is riveted but the roof and bottom are welded. The tank is 78 ft. in diameter, and is one of the largest molasses tanks ever to be built.

Decreasing The Respiratory Hazard In Welding

By A. D. BRANDT
Industrial Hygiene Engineer

THE respiratory hazard from welding may be divided into three general classes: (1) Poisonous substances which may be volatilized by heat; (2) Poisonous gases which may be generated by the arc or by faulty combustion; (3) Exhaustion of oxygen in air.

Lead poisoning is the principal and typical hazard in the class of poisonous substances which may be volatilized by heat. It occurs very frequently when metals covered with lead paint are cut by either the electric arc or the oxyacetylene flame. In such operations, the heat volatilizes the lead in the paint, forming lead fume, which results in rapid and severe lead poisoning to the unprotected welder[1]. This has come to be recognized as an important industrial hazard and many cases have been reported in this country and abroad, especially in connection with scrapping ships.

Welding or cutting brass or zinc (galvanized sheets) frequently results in metal-fume fever, commonly called zinc chills or zinc ague[2]. Even though this illness is temporary, and seldom if ever serious, it is far from pleasant. Consequently, welders as a rule prefer to weld or cut metals which have not been galvanized.

Chemical Cartridge Respirator.
(This is a "junior size" device, which can be worn beneath a welding helmet.)

Coated welding rods are employed widely at present. While it has been intimated that some coatings contain ingredients which are quite toxic when volatilized, very little information either pro or con is available on this point.

Poisonous gases, of which nitrogen peroxide is probably the most important, are generated by an electric arc[2]. Only recently, the death of a welder was attributed to this gas[3]. In this instance, the worker was electrically welding together two halves of a hot-water tank in a room of about 4,000 cu. ft. capacity. All welding was done on the outside of the water tank. The man became unconscious while welding and died 6 days later in a hospital.

Nitrous-Fume Poisoning Develops in Closed Space

About two years ago a number of cases (one fatal) of gassing with nitrous fumes generated by oxyacetylene torches were reported abroad[4]. The men were employed on a steamship at heating with two large oxyacetylene burners a heavy steel crosshead for the purpose of removing it from the rudder post. The compartment in which the men worked had a capacity of approximately 5,000 cu. ft. and was being ventilated at a rate of about 240 cu. ft. per minute by means of a fan. After about 40 minutes work, several men collapsed and one died in a hospital 32 hours later. The symptoms were typical of poisoning by nitrous fumes and tests of the air showed nitrous fumes to be present in large amounts.

If welding, particularly with oxyacetylene torches, is done in closely confined spaces, the oxygen of the air may be reduced to a dangerous level. Fortunately, cases of illness or death due to oxygen depletion in welding are surprisingly rare.

Supplied Air Respirator.
(This device, supplied with an under pressure, is worn beneath a welding helmet.)

The welders and other workers in close proximity may be protected against the respiratory hazards described above by one or a combination of more than one of the following methods:

(1) General ventilation of the work place.

(2) Local exhaust ventilation with discharge of fume and gas outside the workroom.

(3) The use of supplied-air respirators.

(4) The use of respirators containing both adequate filters and gas-absorbing cartridges or canisters.

Welding is carried out today with little regard to ventilation. Machine shops, foundries, and similar buildings with high ceilings are generally ventilated by natural means or by roof stacks and ventilators. Where welding is done in moderate amounts on the floors or benches of such buildings, there is rarely a respiratory hazard to anyone but the welder himself. In such cases the welder should wear a respirator.

Low Ceilings May Cause Unpleasant Conditions

In a building with a low ceiling the fumes from welding soon cause a perceptible haze, which may increase until conditions become unpleasant. Forced ventilation in conjunction with respirators for the welders will render such air

Fumes Arising From Welding.
(The small exhaust hoods in the foreground are connected with blower pipes, but are not operating.)

Fumes Removed Through Exhaust Hoods.
(Although the hoods are small, they function effectively when the blower is turned on.)

suitable for respiration, but will be more expensive, as a rule, than local exhausts.

While general ventilation reduces the pollution of the air of the entire work shop considerably, it rarely affords ample protection to the welder. This is due to the fact that the fumes from the welding operation rise directly to the welder's face before they have been diluted to a large extent.

Local Exhaust Hoods Insure Uncontaminated Air

Wherever welding is done in large amounts, it is recommended that local exhaust hoods be employed. Hoods held within 6 in. of the welding arc or flame, and exhausting to a suitable flue, easily keep the working conditions clean and insure the welder of clean air. A hood 3x5 in., located about 5 in. from the welding operation, requires approximately 200 cu. ft. per minute while much less air flow suffices if the hood is brought closer to the arc[6]. Any hood with an air flow such that the velocity at the point of fume and gas generation is 200 feet per minute will collect the fumes and gas very effectively.

Exact design or specifications are unnecessary because the failure or success of any exhaust hood is very obvious by sight, particularly in a dark room. Also, complete assembled units of this type are not manufactured, because no two jobs are alike. During the past most welding industries have designed and assembled their own exhaust systems, or if of a permanent nature, have had them installed by qualified ventilation engineers.

In constructing the modern light cruiser, destroyer and the like, the current practice is to weld most seams, thereby reducing the riveting (also the weight) to a minimum. In such operations local-exhaust ventilation is used extensively. For the greater part hoods are not employed because of the inconvenience, but the inlet to a 1½ in. corrugated rubber tube is kept very close to the arc and the air is exhausted to the outside by a light and inexpensive rotary blower of the vacuum cleaner type.

While such devices do not exhaust all the fumes, they decrease the pollution to a marked extent. In addition to local exhaust ventilation, forced ventilation and respirators are in common use. With this combined system of control, cases of poisoning in ship construction are very rare, notwithstanding the fact that most of the welding is done in closely confined quarters.

Wherever practicable, local exhaust hoods are desirable because they protect the welder as well as the other workers by eliminating the fumes and gases at the point of generation. Exhaust hoods serve also as an aid in good housekeeping by collecting the fumes before they get into the general atmosphere from which they would slowly settle out about the workshop.

It is a general rule in respiratory protection that supplied-air respirators, commonly called air-line respirators, give the safest and simplest protection possible. A man wearing a good air-line respirator can enter any irrespirable atmosphere, providing it does not affect his eyes or do harm by absorption through the skin. Air-line respirators may be worn conveniently and comfortably beneath a welding helmet. According to Drinker *et al.*[5] an air-line respirator was worn beneath a welding helmet while welding in an atmosphere made irrespirable by the addition of 15% carbon dioxide and rendered so thick with iron-oxide fumes that visibility was very poor.

Air Should Be Cleaned Before Being Fed Into Respirators

An air-line respirator presupposes a suitable supply of clean compressed-air which is often not available. If air from a compressed-air line is supplied to a man wearing an air-line respirator, it should be cleaned by passing through an efficient compressed-air cleaner. It is highly recommended that the air to be supplied to air-line respirators be compressed by rotary blowers or low-pressure compressors in which the air does not come in contact with oil, thus avoiding the possibility of carbon-monoxide poisoning.

Air Regulator Valves Are Aid to Welder's Comfort

While not essential, it is important that air-line respirators be supplied with a valve in easy reach of the wearer, so that he may regulate the air flow to the respirator with ease. In cases where the air is supplied from a high-pressure line (60 to 100 lb. per sq. in.) a valve on the respirator is recommended as a safety feature also. For welding purposes, the face mask should be of the half-mask type, so designed that goggles may be worn if necessary. The mask should contact the face fairly well. The exhalation valve must be of ample size to allow easy egress to both the air supplied to the respirator and the air

Chemical Cartridge Respirator.
(This is used conveniently with goggles in oxyacetylene welding.)

exhaled by the wearer during the period of exhalation. A worker wearing an air-line respirator is receiving the proper quantity of air when the exhalation valve shows a slight but definite out-flow during the entire period of normal inspiration.

Since it has been found[2, 4] that poisonous gases are formed in welding and cutting, a filter-type respirator must contain both a mechanical filter to take out the fumes or particulate matter and a chemical filter to absorb the harmful gases.

Chemical as Well as Mechanical Filters Are Desirable

Any of the several respirators now approved by the Bureau of Mines will catch iron, zinc or similar oxide fumes (although not those of lead oxide), but respirators less carefully made will also suffice. Most welding fumes are readily filtered out, and plug up filters with great vigor. The mechanical filter should be followed by a chemical filter, such as a chemical cartridge or canister. This chemical filter should contain activated charcoal, or preferably a mixture of activated charcoal and soda lime.

The Bureau of Mines "approved" gas-mask canister, designed for protection against acid and organic vapors and smokes, will protect against both fumes and gases from welding, but is needlessly heavy and cumbersome for welding jobs. Abundant practical experience indicates that respirators of the chemical-cartridge type with an additional filter before the cartridge will protect welders against any but the most dense atmospheres.

Most cartridges supplied with respirators of the chemical-cartridge type contain a filter disc as an integral part of the cartridge. Such filters retain a large percentage of the fumes, thereby plugging very rapidly. Consequently, the cartridge must be discarded because of resistance to breathing long before the chemical filter is worn out. To avoid this, the respirator should be so designed that an extra filter disc may be employed in front of the cartridge. When the resistance through this filter becomes excessive, it may be replaced by a new filter disc and the cartridge may be used until it is no longer effective.

Respirators Should Fit Face of Welder Closely

Respirators of the filter type must afford a close fit between the mask and the face of the wearer, otherwise there will be an inward leakage of contaminated air due to the suction created within the mask when the wearer inspires.

In most cases it is impossible to wear the usual chemical-cartridge respirator beneath a welding helmet, owing to the small space between the helmet and the face. To overcome this difficulty, junior-size cartridges are being offered to the welding trade, but such cartridges contain so little chemical that they must be employed with discretion.

Many large shipbuilding companies are using great quantities of air-line respirators and chemical-cartridge respirators with apparent success. Respirators both of the air line and cartridge type are manufactured by several protective safety equipment manufacturers.

To summarize: The respiratory hazard from welding may be divided into (1) Poisonous substances which may be volatilized by heat, (2) Poisonous gases which may be generated by the arc or by faulty combustion, and (3) Exhaustion of oxygen in air.

The methods of protecting welders and other workers against the inhalation of poisonous fumes and gases produced in welding are, in the order of their importance, (1) Local exhaust ventilation, (2) Air line respirators, and (3) Filter type respirators, including both a mechanical and a chemical filter. (Such respirators are not safe if there is a deficiency of oxygen.)

General ventilation alone, either natural or artificial, usually does not afford adequate protection, even though it reduces the pollution to a considerable extent. Its importance in all places where welding is being done must not be underestimated.

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Welding Technicians Map Research Program

The Subcommittee on Industrial Research of the Engineering Foundation Welding Research Committee held a two-day session, July 23-24, at Watertown Arsenal, Watertown, Mass. Colonel G. F. Jenks, commanding officer of the arsenal and chairman of the subcommittee, presided at the various sessions.

The purpose of the conference was to complete the organization of the sub-subcommittees preliminary to the analysis of research activities being conducted to solve the many complicated problems in the welding field. Colonel Jenks pointed out that this work was of great importance to all branches of the metal-working industry, including governmental departments, railroads, shipyards, automotive, aircraft structures, buildings, bridges, and pressure vessels.

The work was divided among various sub-subcommittees including the following material sub-subcommittees:

I—Cast Iron, (chairman not yet named); II—Carbon Steels, J. C. Hodge, chairman; III—Low-Alloy Steels, J. H. Critchett, chairman; IV—High-Alloy Steels, T. H. Nelson, chairman; V—Aluminum Alloys, G. O. Hoglund, chairman; VI—Copper Alloys, D. K. Crampton, chairman; and VII—Nickel Alloys, O. B. J. Fraser, chairman.

Three functional sub-subcommittees are being organized: (A) Methods of Testing, M. F. Sayre, chairman; (B) Analysis of Weld Failures, (chairman not yet named); and (C) Weld Stresses, Causes and Effects, E. Chapman, chairman.

The two-day session included the presentation of papers and reports on radiography, monel metal, low-alloy steels, and high-velocity impact tests. Members of the subcommittee had an opportunity to witness various welding operations at the arsenal, the centrifugal casting of low-alloy steel, and the testing of metals under impact loads delivered at a rate of more than 300 ft. a second.

H. C. Mann, in charge of the work on impact testing, stated that he had found that almost every metal had a critical transition velocity at which its ability to withstand impact loads fell off very sharply. Through the results of these tests the arsenal was able to select those materials which were best suited for the various services encountered in ordnance work.

The Lynn Works of the General Electric Co. acted as host to the scientists and engineers, and demonstrated the wide applications of welding in the construction of all types of dynamo electric machinery and boilers.

A second conference is planned for the middle of October in Cleveland during the Fall meeting of the American Welding Society and the National Metal Exposition.

Dr. C. A. Adams, chairman of the Welding Research Committee, reported that the Engineering Foundation had made three grants totaling $12,000 to launch the project and that leaders of industry had pledged whole-hearted cooperation.

When pipe is threaded, the loss in wall-thickness ranges from 52.6% in average 1-in. pipe to 26.6% in average 12-in. pipe. When pipe is welded into the line, the strength at the junction points is often increased.

Methods of LEAD WELDING Differ Widely From Practices With Other Metals . . .

By F. E. ROGERS and W. H. CARTER
Air Reduction Sales Company

LEAD burning, so-called, is the welding of lead with a gas torch. The edges of the lead are fused and flowed together, using no solder but pure lead only to fill and reinforce the joint when filler is required. The term "lead burning," therefore, is a misnomer as the metal is not "burned," but is fusion welded as other metals are welded with the torch. The methods, however, are quite different from those used on other metal welding.

The process is employed in applying the lead linings of acid and other tanks used in chemical plants, fertilizer factories, rubber-reclaiming works, electroplating shops, artificial silk or rayon factories, nitroglycerine huts, and industrial plants employing corrosive liquids.

Tools Used in Lead Welding.

(Handsaw, Mallets, Pliers, Scrapers, Chisel, Rasp, Snips, Cutter, Burnisher, Lead Filler or Welding Rods.)

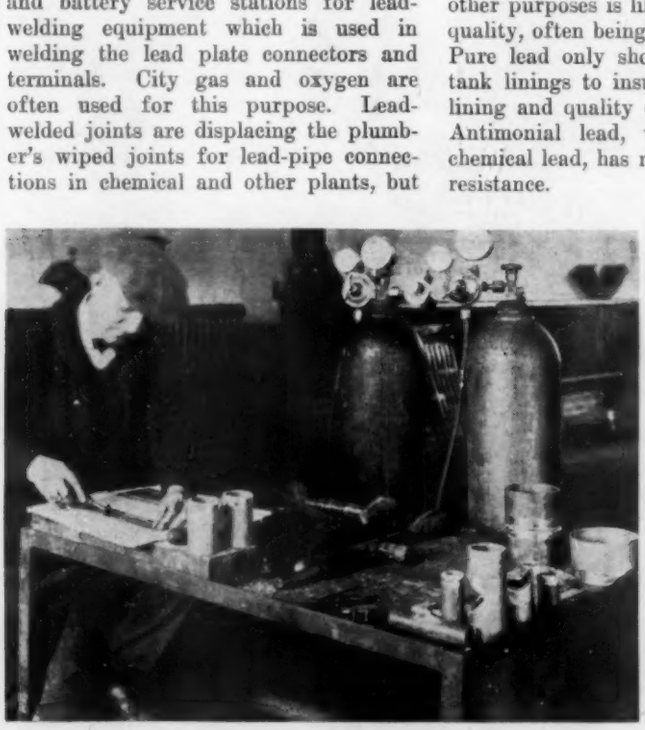
Uses for Lead Welding Are Many and Varied

The widespread use of storage-battery starting and lighting systems on motor cars and trucks has created a demand in battery-manufacturing plants, garages and battery service stations for lead-welding equipment which is used in welding the lead plate connectors and terminals. City gas and oxygen are often used for this purpose. Lead-welded joints are displacing the plumber's wiped joints for lead-pipe connections in chemical and other plants, but tank linings and storage-battery connections are the chief applications for which lead-welding equipment is used.

Tank linings for acids are or should be made of "chemical" lead—that is, sheet lead free from impurities. Ordinary sheet lead used for gutters and other purposes is likely to be of inferior quality, often being made from old lead. Pure lead only should be used in acid tank linings to insure durability of the lining and quality of the welded joints. Antimonial lead, while stronger than chemical lead, has not as good corrosion resistance.

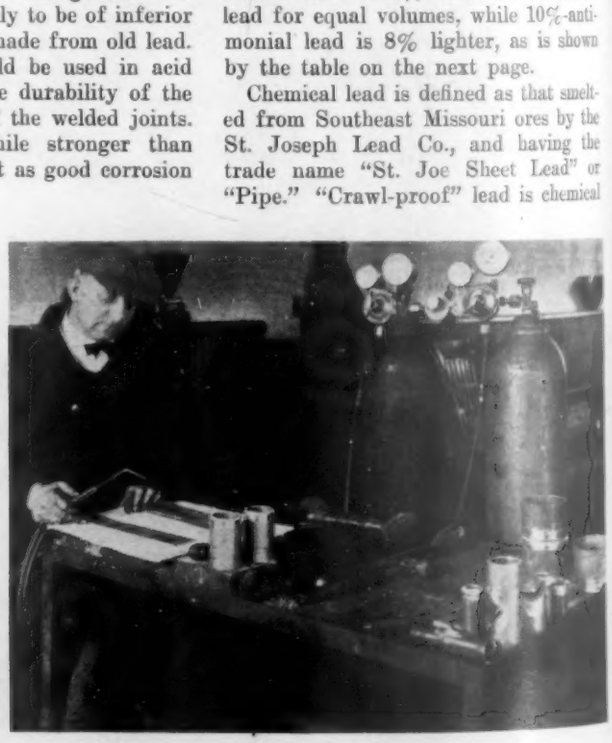
Chemical lead is denser and heavier than antimonial lead, and has higher acid-corrosion resistance. But for situations requiring strength and freedom from "crawling," 6% to 10% antimonial lead is used. The weight of 6%-antimonial lead is 5% less than chemical lead for equal volumes, while 10%-antimonial lead is 8% lighter, as is shown by the table on the next page.

Chemical lead is defined as that smelted from Southeast Missouri ores by the St. Joseph Lead Co., and having the trade name "St. Joe Sheet Lead" or "Pipe." "Crawl-proof" lead is chemical



Operator Scraping a Joint.

(All oxide must be removed before welding lead. The operator is here working on 8-lb. sheet lead.)



Equipment for Lead Welding, and Prepared Samples.

(Note the special lead welding torch, which is hardly more than a bent tube.)

Making a Butt Weld.
(The weld is the reinforced ripple seam illustrated in the next column.)

lead strengthened by antimonial lead-bars running the length of the sheet and protected by the chemical lead.

Tellurium lead is an alloy lead containing about 0.1% tellurium to increase acid-corrosion resistance and tensile strength.

Considerable skill is required of a lead welder to unite lead sheets rapidly and uniformly. The beginner is likely to overheat and "burn" holes in the joint, to say nothing of his difficulties in making welds rapidly that measure up to the standards of lead-joint work. The trade is quickly learned, however, by an intelligent workman, provided he has competent instruction and suitable equipment. Success depends on good tools, thorough preparation, clean surfaces, suitable gases and apparatus, pure lead and proper working conditions, as well as the skill of the operator.

Butt Joints and Simple Lap Seam Both Used With Sheet Lead

Two forms of joints are used with sheet lead—the butt and simple lap seam. Both are employed in tank lining and also in lead-pipe jointing. In preparing a butt joint between the heavier weights of sheet lead when filler is used, the edges should be trimmed straight and beveled to an angle of 75° to 80°, making a vee of about 30° included angle when the two sheets are butted.

The sides of the sheets are scraped clean of oxide, about ½ in. from the edge, using a sharp "shave-hook." The edges are tacked, placing the tacks about one foot apart, and the groove between is filled with molten lead fused from a welding rod or "burning bar." The seam is usually reinforced with lead, which is so applied that it flows and forms peculiar patterns, the shapes varying with the spacing and amount deposited from the filler bar at the successive points of application.

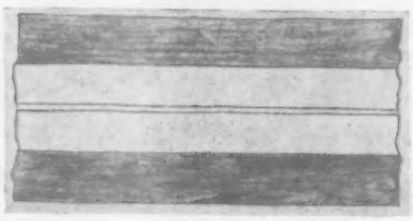
Butt joints are not much used in tank linings, however, except with very heavy lead, so thick, in fact, that it is rarely employed. When making butt welds, all thicknesses up to, say, 12 lb. to the sq. ft. (3/16-in. thick) are butted with square edges, and generally are welded with filler rod. The edges of sheet lead heavier than 12 lb. are beveled as previously stated to form a vee groove.

When welding a butt joint with filler, the flame envelope or streamer is played on the edges of the sheets until the metal is softened, but is still too stiff to flow freely. Lead is added from the filler rod by fusing from the end, also with the flame envelope, giving the torch and filler rod a peculiar periodic up-and-down movement which deposits the required amount of molten material on each spot. The deposited molten lead flows and hardens in a pattern depending on the thickness of the lead, weight of the filler rod and amount of lead deposited at each movement.

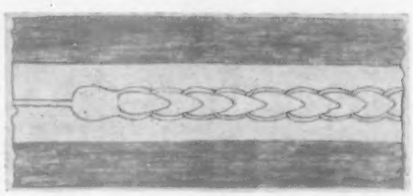
The next application of lead from the filler rod, if accurately spaced, flows into and slightly overlaps that previously laid on. The lead welder progresses in this manner, depositing "globs" of molten lead evenly spaced along the length of the joint.

Lap seams are mostly used in tank linings, especially in the vertical joints when a smooth surface is not required. In making a lap seam, the top sheet should lap the under sheet about 1 to 1½ in. All dirt and oxide must be removed carefully from the joint with the hook scraper or shave-hook.

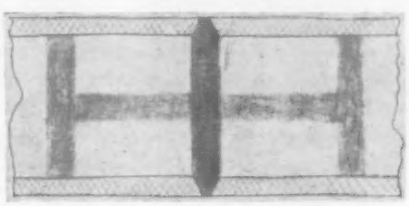
SKETCHES SHOWING VARIOUS TYPES OF LEAD JOINTS



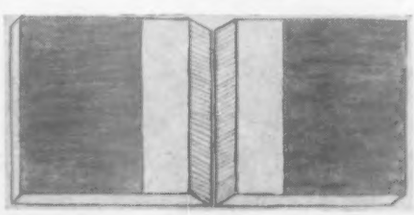
Lead Sheets, Edges Scraped for Butt Weld.



Butt Reinforced Weld, 7/16-In. Ripple Space.



Split Lead Joint in Pipe. Light Lines Show Split Welds. Bottom Welded From Inside of Pipe.



Beveled Lead Sheets Ready for Welding.

No Filler Is Used When Making Lap Welds

When making a lap weld, especially in a vertical joint, the torch flame is directed close to the edge. No filler is used. The manipulation of the torch is quite different from that employed when making flat seams of either the butt or lap type. Not much lead can be fused at a time because of the probability of dropping.

The overlapping edge is "carved" with the flame, and the molten lead slips down and chills on that which was fused at the previous flame application. The lead welder sometimes uses a tool—a shave-hook for example—to hold the sheets close together, and sometimes to help chill the fused metal should it tend to slip down too far or to drop.

The fusion process on vertical seams, the same as on flat seams when filler is employed, is a succession of in-and-out torch movements and progressive movement along the seam with each application of the flame, but the flame is also moved sideways about ¼ in., thus "carving" out a section of the edge, which fuses and flows down and rests against the previous deposit.

Butt Welding Lead Pipe.
(This pipe, of 4 in. diameter, weighs 16 lb. to the lineal foot.)

CHEMICAL LEAD

Melting point	621° F.
Specific gravity	11.38
Weight per cu. ft.	710 lb.
Weight per cu. in.	0.4105 lb.
Tensile strength	1900 lb. per sq. in.
Elastic limit	700 lb. per sq. in.
Linear expansion, 100° F. rise	0.018 in. per ft.

6% ANTIMONIAL LEAD

Melting point	487° F.
Specific gravity	10.81
Weight per cu. ft.	675 lb.
Weight per cu. in.	0.3906 lb.
Tensile strength	3625 lb. per sq. in.
Elastic limit	3000 lb. per sq. in.
Linear expansion, 100° F. rise	0.017 in. per ft.

Lead Welding Bottom to Acid Pot.

The heat required for lead welding is only about 621° F., as compared with 2000° to 2700° F. for welding cast iron and steel. Hence, if a high-temperature gas is employed, it means a smaller tip than when using hydrogen. Small, light torches are used that can be easily handled.

Old-time lead burners were trained to use hydrogen (generated with acid and zinc) and compressed air, but the introduction of oxy-gas welding equipment and compressed oxygen, hydrogen and acetylene in convenient cylinders has changed lead-welding practice to a considerable degree.

Lead Welding Torches Are Simple and Cheap

However, very simple and cheap torches are employed as a rule with hydrogen, consisting of little more than a light tube bent to a gooseneck and fitted with separable tips. The mixed gases are supplied by means of a light rubber tube connected to a bench-block which carries the adjusting needle valves.

This arrangement enables the operator to adjust the valves to the flame he desires, and then he can go ahead with his work without danger that the flame may be changed by accidentally touching the valves, as might happen if the valves were on the torch. With the primitive torch just described, in the case of a flashback all that happens is the rubber tube is blown off the bench-block, as it is not wired to the gland.

Making Vertical Lap Weld.
(On this job no welding rod is used. The material is 6-lb. sheet lead.)

The lead welder necessarily becomes expert in working lead within narrow temperature limits. He must heat the metal at the joint to the near fusing point but not so much that it becomes too fluid and drops away. *He must scrupulously clean the joints and avoid touching them with the hands or anything unclean, as the slightest trace of oil or grease will give trouble.*

The first operation to be learned is to choose the tip size and regulate the flame. The volume of heat necessary will depend upon the thickness of lead being burned and to some extent on the surrounding conditions and the backing.

Twelve thicknesses of lead, ranging from 2 to 60 lb. to the sq. ft., the latter being 30 times as thick as the former, are presented for welding. Hence, it is quite apparent that the lead welder must be able to regulate and adjust his flame to a wide variation.

The cross-section of the lead filler or "burning bars" depends on the thickness or weight of lead to be welded; ⅛-in. wire size is recommended for 2 and 4-lb. lead; 5/16-in. size for 6 and 8-lb. lead; and ⅜-in. and ½-in., depending on the type of seams, for 10-, 12-, 16- and 20-lb. lead.

Size of Rods Must Match Weight of Lead Used On the Job

The importance of using lead welding rods of the correct size for each weight of lead can hardly be over-emphasized. If the bar is too light, the time required to fuse the lead needed for each deposit permits oxidation, because the metal, being light, is likely to be overheated.

If a heavy bar is used with a small flame, the metal does not melt sufficiently to carry on the seam, and the seam chills during the lost-time period while the flame is melting the lead. Fusing the filler is done over the sheet, of course, and the time interval between fusing the burning bar and depositing it on the sheet must be carefully gauged.

If the bar is too heavy or too light, the proper sequence of heating the sheet, fusing the lead, depositing it on the seam, etc., cannot be maintained as to time interval. This means lost time, irregular work, low speed and oxidation, edges of seams not welded, pits, cold-shuts and other defects.

Flame Must Be Proportioned to Weight of Lead

A well-regulated flame of size in proportion to the weight of lead and the proper size of burning bar are important also on pipe work, the same as on sheet lead.

Great care must be taken in properly scraping all dirt and oxide from the surface with the shave-hook before burning. Avoid rubbing the hands over the work after scraping. Always use a dust brush or counter-brush to remove the scrapings or raspings produced in preparing a joint.

Samples of Flame-Welded Lead Joints and Prepared Pieces.

After the lead is scraped clean at the joint, brush the shavings away from the seams and from beneath. Dress the lead down tight to the tank with a wooden mallet, tack the edges together with the torch at, say, every foot, but always keep the lead dressed down flat to the tank surface. This saves time in welding and prevents molten lead from getting beneath the sheet.

When relining an old box or tank where the wood has been saturated with the contained liquors, use a strip of sheet asbestos about 3 in. wide under the seams. The bottom of the tank should be wiped dry and made as free from moisture as possible. The asbestos insures against the acid or liquor soaked into the wood from bubbling up through the seams when the welding is being done. Watch carefully back of the flame to see that bubbles do not break

through. Gas will often do this between the tank and lining, and, of course, if this happens a defective spot is made which must be made tight.

Again, where iron tanks are lead-lined, care must be taken that gases are not formed between the tank and lining. But as this work is in a class by itself, the matter will not be further treated here, except to say that gas formed back of linings is one of the major troubles that the lead welder must guard against.

Upright or vertical seams must be scraped, as follows: Lap the lead 1 to 1½ in., and scrape the lower or back sheet before the lead is dressed down. Do not fail to scrape the under side, as well as the outside. Failure to do this explains why some lead welders have so much trouble in upright or overhead welding. Everything depends in this class of work on properly-prepared joints and proper regulation of flame.

Heat Must Be Watched Carefully on Overhead Work

Remember also that a drop of metal lost on overhead work must be replaced with one from the welding rod or burning bar, otherwise the seam will look bad, and it will be hard to start back at the edge of the sheet. Overhead welding requires practice and care to prevent the flame from distributing heat except where the welding is actually being done.

Lead welding is used exclusively for all kinds of lead work joints in chemical plants. Wiped or soldered joints are never satisfactory. Flanges are used only where lines are to be broken from time to time, due to various causes, such as clogging with sediment or being eaten up by acid or residues and where time is an important factor requiring quick repairs. Even then only a few flange joints are generally permitted. Most joints are welded, making a 100% job, and eliminating leaks, which are almost inseparable from flange joints.

WEIGHTS AND DIMENSIONS OF LEAD SHEETS
(National Lead Company)

Weight, Lb. per Sq. Ft.	Thickness of Sheet In.	Size of Sheet Ft.[1]	Size of Tip Orifice[2]	Welding Rod Dia.,[3] In.
1	1/64	8 x 20	72	..
1½	1/43	8 x 20	72	..
2	1/32	7 x 45	68	1/16
2½	1/24	9 x 45	68	1/16
3	3/64	10 x 45	68	1/16
3½	1/17	10 x 45	68	1/16
4	1/16	10 x 45	68	1/16
5	5/64	10 x 43	68	1/16
6	3/32	11.5 x 30	68	1/16
8	1/8	10 x 40	68	3/32
10	5/32	11.5 x 40	68	3/32
12	3/16	11 x 40	68	3/32
14	4/17	11.5 x 40	68	3/32
16	1/4	11.5 x 40	68	3/32
20	5/16	11.5 x 40	68	3/32
24	3/8	11 x 34	62	1/8
30	1/2	11 x 27	62	1/8
40	5/8	11 x 24	62	1/8
60	1	12 x 12	56	5/32

[1]Other sizes of sheets than those listed are available in certain weights.
[2]Tip sizes are for hydrogen up to 20-lb. lead, inclusive, and for acetylene, 24-lb. lead and up. However, oxyhyhrogen is also used for the heaviest lead. Figures are drill sizes.
[3]No welding rod or "burning bar" size is specified for 1- and 1½-lb. lead. Light lead is generally welded with flanged or standing seams, using no welding rod.

LEAD-PIPE SIZES USED IN CHEMICAL PLANTS

Inside Diameter, Inches	Outside Diameter, In.	Weight per Ft.	Wall Thickness, In.
¼	11/32	4 oz.	1/16
⅜	7/16	8 oz.	3/32
½	23/32	1 lb. 9 oz.	11/64
⅝	11/16	2 lb. 1 oz.	5/32
¾	1–5/32	3 lb. 0 oz.	13/64
1	1–7/16	4 lb. 0 oz.	7/32
1¼	1–43/64	4 lb. 12 oz.	7/32
1½	2	6 lb. 8 oz.	1/4
2	2–1/2	9 lb. 0 oz.	1/4
3	3–1/2	12 lb. 8 oz.	1/4
4	4–1/2	16 lb. 12 oz.	1/4
6	6–11/16	24 lb. 0 oz.	5/16

Wash-out openings are placed in certain lead pipelines so they may be cleaned quickly. When such a line is a vital part of the operation, all joints should be carefully welded so they will withstand more corrosion than the pipe itself, or, in other words, so the welding does not pit the wall of the pipe or take any lead from its thickness. In making such pipe joints, always add from the welding rod or burning bar to build up the seam or joint.

Eight Standard Joints Used in Lead Pipe Work

The following joints are recognized and used in lead-pipe work: Roll, cup, butt, split, flange, burned-in, flange using cast iron or brass flanges, and lap.

Often the maze of lead pipes in a chemical plant includes some so laid that the underside is inaccessible for welding. When it becomes necessary to replace a section and weld it in with butt joints, heavy expense would be incurred for removing and replacing the underneath obstruction, or cutting several side connections and rewelding.

In such cases the pipe ends are split back at the top 2 or 3 in. Cross cuts are made at the ends of the splits about halfway through, or down to the middle of the pipe. The split parts of the pipe are bent outward, thus exposing the inside and permitting the underside of the butt weld to be made by working on the inside of the pipe. When the weld is halfway around, the cut parts are bent back into place and the cross cuts, splits and butt welds are made, thus closing the pipe and completing the job.

Lower Halves of Pipe Ends Are Beveled Inwardly

If the ends of the pipe are beveled, the lower halves are beveled inwardly, and the upper halves as usual.

Unless a lead welder has worked on chemical-plant construction or maintenance lead work, the chances are that he is far from being familiar with lead welding as found in chemical plants. The literature on lead welding of the chemical plant type is scarce, and the little available is incorrect in some particulars. Lead-lined iron tanks, wood vats and concrete tanks have different styles of seams or different uses, and the lead burner must know his job and exercise care to have them lined suitably.

Desk Set Built Up By Weld Beads

About 14 hours of work was required to build the four pieces shown in the illustration, according to the welder, L. A. Nash, 7836 South Shore Drive, Chicago, Ill. The set consists of a desk lamp, two bud vases and ash tray. Both

vases hold water. With the exception of the lamp shade, all work was done free hand, using ⅛-in. washed electrodes. For the shade, a piece of stove pipe was used for the form, and the weld beads were laid over it, obtaining complete penetration and fusing the metal into the beads so it does not show. All the pieces were brushed with three colors of dry bronze.

Vegetable-Oil Refinery for Pacific Coast

A huge welding program is under way by Spencer-Kellogg & Sons, Inc., at Wilmington, Calif., on Terminal Island, in the Los Angeles Harbor. The concern is constructing a large vegetable-oil processing plant, said to be the largest of its kind on the Pacific coast. It will have a capacity of crushing 6,000 to 7,000 bushels of flaxseed per day. The building is largely of structural steel, which with boiler setting and extensive piping system, will make for a great amount of welding.

Coming Events

Sept. 7-12. Washington, D. C. Third World Power Conference. For information write the Conference, Interior Bldg., Washington, D. C.

Sept. 22-25. Detroit, Mich. Iron and Steel Exposition. Also annual convention of Association of Iron & Steel Electrical Engineers. For information write John Kelly, Jr., Empire Bldg., Pittsburgh, Pa.

Oct. 19-23. Cleveland, Ohio, Public Auditorium. National Metal Congress. Also Fall Meeting of American Welding Society and meetings of American Society for Metals, Wire Association, and others. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland.

Nov. 18-20. St. Louis, Mo., Hotel Jefferson. Annual convention International Acetylene Association. For information write the Association, 30 East 42nd St., New York, N. Y.

Welded Forms Speed Construction of 16-Ft. Water Tunnel . . .

THE problem of building a 16-foot reinforced concrete tunnel for the metropolitan water district of Los Angeles, presented a number of difficult engineering problems, the solutions to which involved the construction of a movable steel form, made in four sections, so hinged that after pouring and setting of the concrete the form could be partly collapsed and moved to the next section, concrete again poured, then the form moved again, and so on throughout the length of the tunnel.

300 Ft. of Steel Form Made in 20-Ft. Sections

It was necessary to construct a total of 300 ft. of steel form, in 20-ft. sections, which work was carried out in the plant of the Lakeside Bridge & Steel Co., Milwaukee, Wis. This form was horseshoe-shaped with a hinge at the top and one on each leg near the bottom. Inside the form, traveling on steel tracks, is a special apparatus for collapsing the form, moving it and setting in its new position.

Each 20-foot section was made of ⅜-in. plate with stiffeners, consisting of T-sections made by splitting the webs of 12-in. 31.8-lb. I-beams. After each T-section was rolled to its proper shape, and the shell of the form welded to the cut edge of the web, longitudinal stiffeners were added.

The shell of that portion of the section above the lower hinges consisted of four plates, two on each side, 10 ft. long, while that portion below the lower hinges consisted of a 20-ft. plate on each leg, extending the full length of the section.

The end rib of each 20-foot section, instead of being cut from an I-beam, was made by splitting a 12-in. 20.7-lb. channel in half, with the cut edge of the web welded to the shell. To join one 20-ft. section to another, the half channel at the end of one section was bolted and pinned to the half channel of the adjacent section.

At the top of each of the two sides of the form was an angle section running the entire 20-ft. length, which was made from a 12-in., 25-lb. channel by cutting along the center line of the web. These angles were welded to the shell, and the top hinge of the form was welded to each angle, thus joining the two sides.

The form had an 8-ft. radius at the top and a 16-ft. radius at the bottom, and it was necessary that these dimensions be held within 1/16 in. Moreover, all joints had to be finished in order to make them tight. Hence, in a structure of this size, it was necessary to use considerable care and planning in order to keep the structure within tolerances, yet prevent binding of the hinges.

Each 20-ft. section was made in six different parts, there being two 10-ft. sections in each leg of the form, extending from the lower to the upper hinge, and one 20-ft. section at the bottom of each leg, below the lower hinges.

Assembled in Special Fixtures, Then Welded on Manipulator

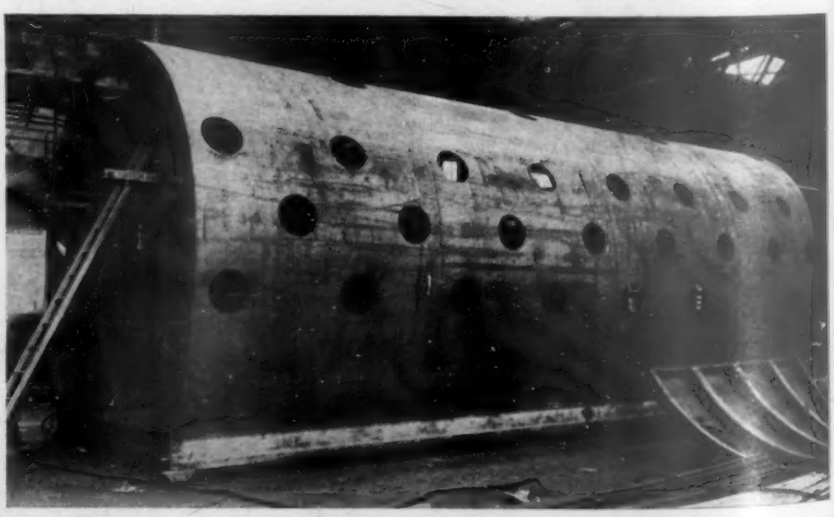
The shell plates, corresponding to A. S. T. M. specification A 7-33, were formed cold to the proper radius. The T-sections, cut from the I-beams forming the vertical ribs, were formed hot. Each assembly, consisting of shell plate, vertical T-ribs, and horizontal plates to act as stiffeners, was assembled in a special fixture and tack welded, after which the section was bolted to a manipulator and all seams welded in the downhand position. All welds were ¼ in. minimum.

The T-sections were welded to the shell plates with 6-in. welds, spaced 6 in. between ends, and alternating on each side of the T-section web. Continuous welds were used along the end angles cut from channels.

At the lower hinge, 6 x ⅝-in. bars were welded along the entire length of the upper and lower parts where they come together, and a 6 x 4 x ½-in. angle was welded on the bottom of each lower part along its entire 20-ft. length, these angles being fastened to the manipulating apparatus which opens and closes the form for pouring and moving.

Circular Holes, Equipped With Doors, Allow Inspection of Concrete

To allow easy inspection of the poured concrete 28 holes, each 18 in. in diameter, provided with doors, were cut in the shell of each 20-ft. section. The doors, when locked in position, were flush with the shell, giving a continuous outer surface to the form. These doors open from the inside and were formed by cutting circular holes in the shell plates, using a machine torch, while the plates were still flat. The circular pieces thus cut out of the plate were position marked and used for doors to fit their corresponding holes. After cutting out, each door was bent to its proper radius to conform to that of the plate.



20-Ft. Collapsible Concrete Form For Los Angeles Water Tunnel.
(300 ft. of these sections were assembled by welding. An interior mechanism collapses and moves the form ahead for the next pouring.)

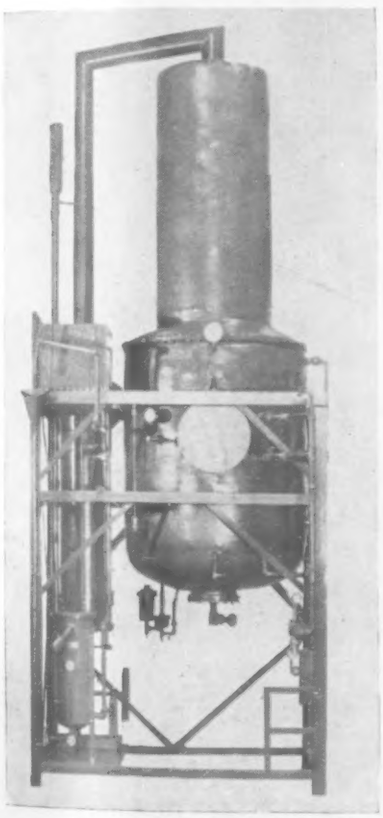
Each part, as it comes from the assembly fixture, has the correct shape and contour, but after welding in the manipulator, there is a tendency for the piece to straighten upon cooling. To counteract this, three turnbuckles are strapped across the top of each of the pieces when they are bolted to the manipulator, and these are tightened so as to increase slightly the radius of the piece. A definite welding sequence is followed, and after the piece is welded and the turnbuckles are released, it returns to its correct shape and radius on cooling.

After all parts are completed, they are assembled in the shop to form a complete 20-ft. section. This is accomplished by lining up the finished parts and reaming them for dowels and turnbolts.

Proper Welding Procedure Makes Close Tolerance Possible

On the first of these sections built, the proper welding sequence was established and proper correction given to each assembly so that after cooling all dimensions would be within the small clearance allowed. This procedure was followed on all the other sections. With such a procedure, it has been demonstrated that even so large and complex a structure as this one can be welded and kept within close tolerances.

Notes on Metal Spraying



Refinery Still

The still unit shown was fabricated from sheet steel, steel pipe, etc., are welded. It was handled in sections with a hoist and all parts were "metallized" with tin before being assembled at the customer's plant. While blasting with steel grit, each piece was used as a bell resting on the steel-plate floor, with a dust-arrester working through the manhole. After this operation, each part, including lower and upper sections and heating element, was suspended in the hoist while being "metallized."

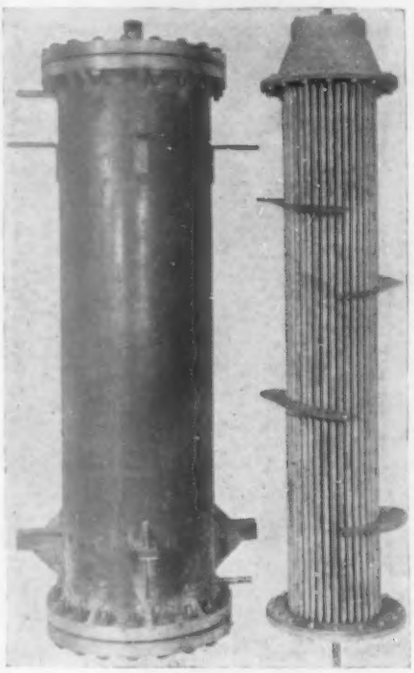
The object of "metallizing" the complete unit was to prevent the fluid oil-and-solvent mix from picking up contamination from the steel while in process. The unit was manufactured by the Bousman Manufacturing Co., Grand Rapids, Mich., for an oil refinery, and the "metallizing" work was done by A. B. Millard, Grand Rapids Trust Building, Grand Rapids, Mich.

Aluminum Reduces Glare of Display Signs

Aluminum sprayed on sheet-iron neon signs prevents reflection and glare and gives a superior result to painting or galvanizing, reports H. B. Rice, of the Metalspray Co., Inc., 113 Llewellyn St., Los Angeles, Calif. Only 0.004 in. of aluminum coating is needed, and this also protects against corrosion for many years. One neon-sign concern in California finds that the aluminum-sprayed sign meets with much favor.

Journals of Street-Car Axles

The building up of the motor journals of street-car axles has been a serious problem due to the fact that it is so easy to set up heat strains and stresses, with possible breakage. One firm is now doing this kind of work, using a heavy-duty metal-spraying gun, says W. C. Reid, of the Metallizing Engineering Co., Chicago, and the heat generated is at no time such that the hand cannot be placed on the surface being coated, even though ¼ in. of metal is being applied.



Heat Exchanger

Stainless steel was employed in "metallizing" a tube-type heat exchanger for an oil refinery, the work having been done by A. B. Millard, Grand Rapids, Mich. The tubes were drawn stainless steel, flared into machine-steel plates at top and bottom. These plates were "metallized" both before and after flaring the tubes. The baffle plates inside and outside the nest of tubes, as well as all gaskets, were also made of stainless steel. All inner surfaces of the main tube section were "metallized" with stainless steel after being thoroughly etched with an angular-steel-grit blast. The large tube, 7 ft. 7 in. long, was suspended upright while the blasting and metal-spray operators worked about half-way in from each end. Down-draft was used for dust-arresting and up-draft for heat-elimination.

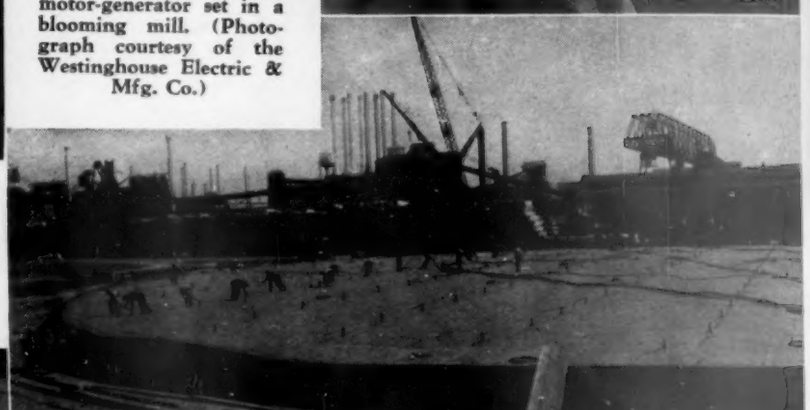
Spraying Car Axle Journal.
(This method permits building up the axle without setting up heat strains and stresses, with possible breakage.)

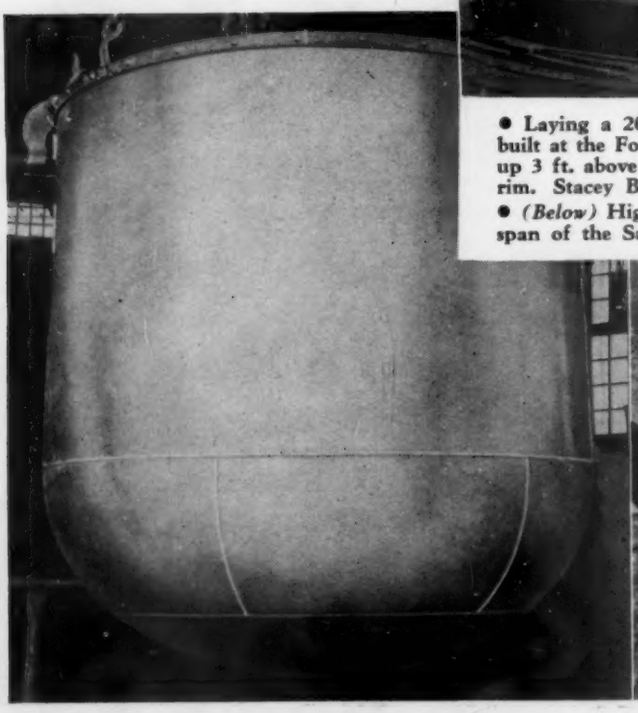
Welding News in Pictures

• *(Right)* Making a circumferential weld on a milk-holding tank, of Enduro stainless steel, in the Canton, O., plant of the York Ice Manufacturing Co.

• *(Left)* Fabricated of five steel plates, welded together, this 180-in. flywheel, weighing 70 tons, will be used to equalize the load on a 6,000-kw. motor-generator set in a blooming mill. (Photograph courtesy of the Westinghouse Electric & Mfg. Co.)

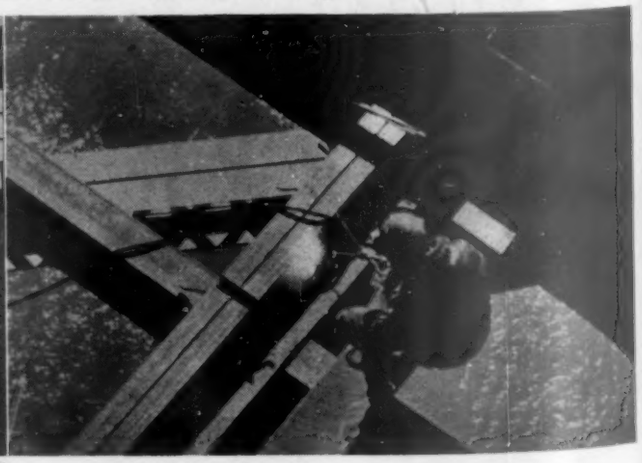
• *(Below)* Open-top milk tank, 54 in. in diameter and 5 ft. 4 in. high, made of Inconel, arc welded in the St. Louis, Mo., plant of the John Nooter Boiler Works Co. Inside joints ground smooth and silver soldered for sanitation reasons.





• Laying a 200-ft.-diameter bottom for the 10,000,000-cu. ft. gas holder being built at the Ford Motor Co.'s Rouge plant. During welding, the plates were held up 3 ft. above the foundation by 160 screw-jacks and balks of wood around the rim. Stacey Bros. Gas Construction Co., Cincinnati, has contract for erection.

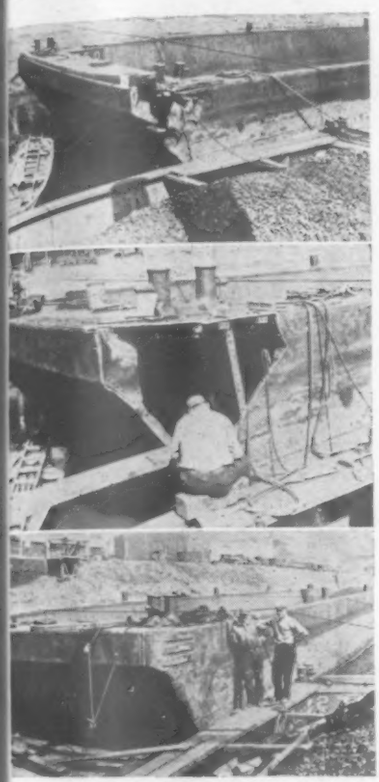
• *(Below)* High above the Bay waters, the welder plies his art on the suspension span of the San Francisco-Oakland Bay Bridge. (Lincoln Electric Co. Photo.)



Damaged Barges Repaired By Welding

By R. W. ORTH
General Electric Company

How the Pittsburgh Welding Co. has repaired 181 damaged river barges with arc welding is indicated by the three accompanying illustrations, showing a



Views of Damaged Barge, Before, During and After Repair.

barge with a damaged corner before, during, and after the welding operations. According to E. H. Pacy, president of the company: "Of the 181 barges welded since 1933, not one has had a weld failure in spite of the severe punishment the repaired sections must undergo in service."

Waterway Freight Increases in Pittsburgh District

The remarkable movement of freight on the Ohio, Monongahela and Allegheny Rivers is expected to result in increased inquiries and orders for the large barge building companies in the Pittsburgh district. Even at this time, all the shops are exceptionally busy and the majority of business placed is for welded equipment.

Commenting on the remarkable increase in the movement of freight on the Ohio river, A. G. Wakefield, chief administrative assistant in the office of the U. S. Engineers at Louisville, said: "If the tonnage increase in that district during the first six months of 1936 may be accepted as an index to the movement on the upper river, the total tonnage of the Ohio River this year will exceed any former record."

According to statistics released by Col. Gilbert Van B. Wilkes, district engineer, the total originating tonnage for the first six months amounts to 1,107,585, as against 988,544 tons during the same period in 1935. The gain in commodities was: cement, 70%; forest products, 52%; stone, 80%, and beer, 47%. There also was a large increase in the movement of automobiles, coal, tobacco, whisky and packet freight.

One of the outstanding increases is in the movement of oil, which threatens to lead coal as the principal commodity moving on the three rivers. Some idea of this vast increase may be gained from statistics recently disclosed which show that the oil tonnage has increased from 37,761 tons in 1927 to an estimated 587,844 tons this year. During the past six months, notwithstanding suspension of freight movement during the St. Patrick's Day flood, the oil tonnage has amounted to 301,144 tons.

The use of welded equipment for moving this vast tonnage of oil, and other commodities, is indicated by a few of the orders which have been placed during the past few months. These include 4 oil tank barges for the Campbell Transportation Co. of Pittsburgh; 11 welded oil tank barges, with riveted hulls, for the American Barge Line of Louisville; one oil tank barge for the Aetna Oil Refining Co., also of Louisville; two welded barges for the Gulf Refining Co. of Pittsburgh; and four sand-and-gravel dump scows for the U. S. Army Engineers of the Pittsburgh district. In addition, there are many other inquiries pending.

Welded Tank Subjected to Severe Drop Test

Recent drop tests were conducted by The Davis Welding & Manufacturing Co., Cincinnati, O., with a 150-gallon gallon welded tank fabricated from 14-gauge Yoloy hot-rolled steel, a nickel-copper alloy steel of high yield and ultimate strengths, made by The Youngstown Sheet & Tube Co., Youngstown, O.

Shielded-arc welding was used. The test compartment was of the type used by this large fabricator in multiple-compartment vehicle tanks for hauling gasoline, oil and other petroleum products.

After the tank had been filled with water, it was dropped from a height of 30 ft. onto a heavy metal plate. Instead of hitting on the extreme end of the oval section, as intended, the tank actually landed on the one corner seam at the first drop. However, there was no indication of any break in the weld, and the test was repeated from the same height. The tank landed on the opposite side on the second test, which also failed to disclose any weakness in the weld.

Ralph Furrer Allis-Chalmer Industrial Engineer

Ralph Furrer has been appointed industrial engineer of the manufacturing department of the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. In 1907 he was employed at the former Scranton Plant of that company, being transferred in 1911 to the West Allis Works, where he was engaged in drafting and engineering work. In 1918 he joined the A. O. Smith Corp., of Milwaukee, as mechanical engineer. During the World War he was with the aviation division of the U. S. Naval Reserve Corp. Later he became supervisor of construction at the A. O. Smith Corp., and from 1927

RALPH FURRER

to 1932 held the position of chief engineer and director of research. Then for three years he was assistant to the vice-presidents of the National Tube Co., prior to his recent appointment with Allis-Chalmers.

British Specifications on Protective Glass

"Protective Glass for Welding and Other Industrial Operations" is the title of a new British Standard Specification, known as B.S.S. No. 679-1936, which may be obtained from the Publications Department of the British Standards Institution, 28, Victoria St., London, S. W. 1, England, for 2s. 2d. In these Specifications, welding glass is graded according to its density, and five standard ranges are given. Also included are dimensions for the size of lenses for goggles and for the windows in shields.

Machine parts of welded rolled steel are frequently 50% lighter than where the same part is made of cast iron.

Low-Temperature Brazing With Silver Alloys . . .

By PHILIP KRIEGEL

THE advantages of the so-called hard solders over soft solders are generally appreciated, especially when due emphasis is placed upon their physical characteristics and longer service life under conditions of stress. Silver solders present a still further advance in their contribution to the art of brazing because of their ability to join permanently a greater number and combination of metals and alloys than can any brazing alloys of the baser metals. Moreover, recent developments have brought melting points of certain silver brazing alloys to as low as 1175° F., thereby increasing the range of their brazing utility.

A great variety of silver alloys have been developed to meet general requirements for application to metal parts over a wide range of temperatures. Starting at a melting point of about 1600° F., these solders flow at progressively lower temperatures as the silver content increases. Between 1175° F. and 1600° F., silver solders present a melting range which makes possible brazing of extruded, drawn or stamped non-ferrous parts or thin steel sections. With alloys of baser metals requiring temperatures between 1600° and 2100° F., the tendency to burning and distortion of light gauge sections, especially in stainless steel and copper-nickel and chrome-nickel alloys, is self-evident.

Silver Alloys Have High Physical Properties

The remarkable strength of silver alloys is based on the inherently high tensile strength and ductility of silver itself. They are remarkably resistant to fatigue from bending, vibration, shock and temperature changes, thereby lending themselves well to many types of equipment. With such physical advantages it is noteworthy how extensively silver solders are now being applied: brazing of steel and brass parts in surgical and surveying instruments, engine manifolds, turbine blades; joining of copper, brass and bronze extruded tubes and box sections, rods and wire; joining of sterling silver, copper, brass and nickel sheet before drawing, cold hammering or spinning; soldering of fuel-oil lines, automobile steering sections and radiators, radio loud speakers, etc.

Because of their general resistance to ordinary corrosion in industrial processes, silver alloys are used extensively in brazing cauldrons, cookers, tanks, stills, coils, piping, etc., for chemical, food products and kindred industries.

Prepared under the exacting conditions required for their production, with definite compositions, these silver alloys have definite and unvarying electrical conductivity and resistance values. Because of this valuable property, silver-brazed joints are used extensively in motors, generators, electrical signal systems, telephone switchboards, refrigerators, heaters, toasters, delicate X-ray equipment and many other intricate electrical devices.

Silver Solders Flow Freely and Bond Quickly

Good silver solders are free-flowing within their respective temperature ranges and have a remarkably quick penetrative quality, alloying readily with the adjacent metal sections and forming a firm, sound bond. The photomicrograph shown in Fig. 1 indicates the degree of penetration of the solder into the brazed parts, one of the reasons why the joint is generally stronger than the metal parts it joins.

Silver solder is economical to use. It is a delusion to believe that because the essential alloying element is relatively expensive the cost of silver brazing is high. Very little of the solder need be used regardless of the nature of the joint to be made. In fact, so little of the solder is required to make a joint that the joints often become virtually inconspicuous. There are no objectionable ridges of solder in a well-made joint. For this reason it is ideally suited to brazing of parts that go into precious-metal novelties, watches and clocks, instruments of all kinds, sterling-silver plated ware, etc.

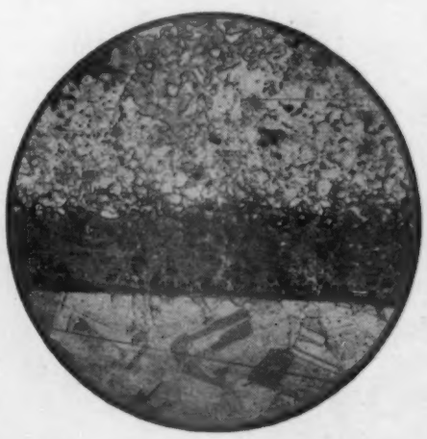


Fig. 1.—Photomicrograph of Silver-Brazed Joint.

(Note degree of penetration of solder and its relatively fine granular structure.)

Stainless-Steel Specimens Show High Strengths

A well-known, reputable manufacturer of silver solder and brazing alloys claims (on the basis of extensive investigations substantiated by independent tests) that silver-soldered joints very often are stronger than joints brazed with other types of brazing alloys, and are often stronger than the base metal itself. An excellent example is contained in comparative tests conducted on specially treated 18-8 stainless steel. Pieces ¾ in. x 6 in. x 20-gauge were spot welded at two spots on a 1-in. lap, forming specimens 11 in. long.

Some of these test pieces were tack welded and then oxyacetylene welded on one of the laps, some were fully reinforced with soft solder in the entire joint, and others were brazed for only half the joint length with a silver solder melting at 1175° F. After removal of any surface oxides, an equal number of each of the three groups of test pieces were immersed in a 20% salt spray for two weeks.

In tensile tests conducted on the three types of joined pieces before and after salt-spray exposure, the following results were obtained:

Before Salt Spray.—The tensile strength of the joint spot welded and sealed on one edge with soft solder was four-fifths of the tensile strength of the metal, with the spot welds and solder breaking at the same load.

The tensile strength of the joint oxyacetylene welded on one edge was about 1% stronger than the soft-soldered joint.

The tensile strength of the joint sealed on one edge with silver solder was virtually that of the steel itself, inasmuch as the break occurred about ⅛ in. from the joint.

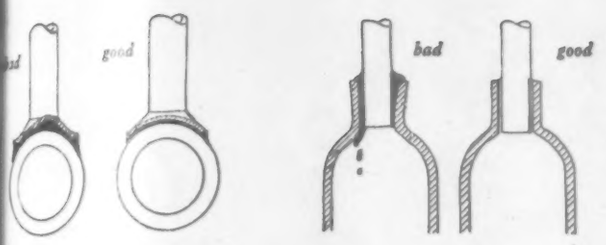


Fig. 2.—Good and Bad Joints.

(Tight fitting joints are the best and most economical. Black areas show the silver solder.)

After Salt Spray. The strength of the soft-soldered joint dropped one-tenth from its original strength.

The strength of the acetylene-welded joint dropped about 1%.

The strength of the silver-soldered joint remained higher than the metal because again the break took place in the steel about 1 in. from the joint.

Properly Brazed Joints Resist Impairment of Microstructure

It was thus shown that a joint properly brazed with a silver solder melting at low temperature can provide adequate insurance against impairment of the joint's microstructure. It is usually stronger than the soft-soldered joint, both before and after exposure to corrosion. Its ability to withstand shearing stresses may be generally regarded to be as good as the metal parts it joins, this depending, of course, upon the particular type and strength of the metals joined.

Two silver alloys, one fusing at 1300° F. and the other at 1175° F., have been widely adopted for work where strength and ductility have to be combined with free flow at temperatures safely below the range of likely injury to the metal to be brazed. Used with a good flux, only a small quantity (virtually a film) is needed for tight-fitting joints. Both alloys are quick working, easy to apply uniformly, at the same time saving labor in the operation, due to their low melting point and reduced preheating of the metal. The solder flowing at 1175° F. is particularly suited to joining monel metal, nickel and its alloys, copper, brass, bronze, stainless steel, iron and steel, and other metals where fast working at about 1200° F. for brief periods is desirable. A high degree of strength and ductility is, nevertheless, effected, with tensile strengths obtained of 40,000 to 60,000 lb. per sq. in., and up to 70,000 to 90,000 lb. per sq. in. or higher on stainless steels.

Good Work Results from Following Proper Procedure

Brazing with silver solders is relatively simple. It presupposes a definite procedure carefully followed to produce good work.

To obtain satisfactory joints the solder must be melted. For this purpose oxyacetylene torches are preferred because high temperatures can be obtained with a reducing flame. Gas from city mains, with or without oxygen, can be used satisfactorily under some conditions. The torch flame should be played uniformly over the part to be heated to prevent overheating in spots and excessive oxidation. The temperature of the heated surface should be somewhat higher than the flow-point of the silver alloy to be applied thereon.

Where the parts, especially on production work, can be assembled with solder and flux in or along the joint, furnaces can be used for heating. These may be electric, oil or gas fired. Resistance heating may be employed for many types of work, giving the maximum desired heat rapidly where soldering is to take place, without undue heating of contiguous parts of the metal.

Flux Must Liquefy at or Below Melting Point of Solder

As is generally known, the purpose of a flux is to assist in the free flowing of the solder and at the same time protect the metal to be joined against oxidation as well as to dissolve whatever oxides may be formed during heating. Obviously, therefore, a flux which will liquefy at or below the melting point of the solder and will not readily volitalize is to be desired.

Borax serves as the base for many fluxes. It has some advantages and also certain shortcomings. It rapidly takes up water of crystallization, when a paste is made up. The borax and boric-acid combination is frequently used for ordinary requirements.

But despite the compensating features of one or the other, there are limitations upon the degree of fluidity which set the temperature of usefulness in silver brazing between 1400° and 1600° F., increasing to the higher temperature with the increase of boric-acid content. Other salts must therefore be added or mixtures of entirely different chemicals must be employed in order to obtain low-temperature brazing under 1400° F., which is to be preferred in joining stainless steels or other chromium- and nickel-bearing alloys.

Therefore, those employing low-temperature brazing with silver alloys generally turn to other kinds of fluxes, one of these being a patented paste which begins to fuse at 900° F., becomes a thin, active, evenly spreading fluid at 1200° F., and remains stable for use with silver alloys to 1600° F. This flux is readily mixed with water to the desired consistency and applied evenly with a brush over the surface to be brazed. It does not bubble or flow away under the torch, and any excess flux coating can be easily softened and washed away with hot water.

It is obvious that all parts that must be brazed should be thoroughly clean. All dirt and grease should be removed chemically or mechanically. This insures thorough removal of oxides on the metal surface by the flux.

All joints should be well fitted with close tolerances. True economy in silver soldering comes in using only a film of solder or brazing alloy in the joint. The solder serves no good purpose as a filler. The ready penetration of the solder into the joint plus an alloying effect with parts to be joined, is the secret of the joint's strength. Fig. 2 shows the correct way to make tight-fitting joints.

Flux Should Be Applied to All Parts of Joint

Correct application of flux calls for covering all parts of the joint and solder with flux. When used in paste form, the flux should be brushed evenly to cover the surface of surrounding parts. This protects against oxidation, absorbs oxides formed while preheating and aids in the flow of solder. (See Fig. 3.)

The joint and surrounding metal should be heated slowly with a soft flame. By applying the flame to the joint and the metal surrounding it, there

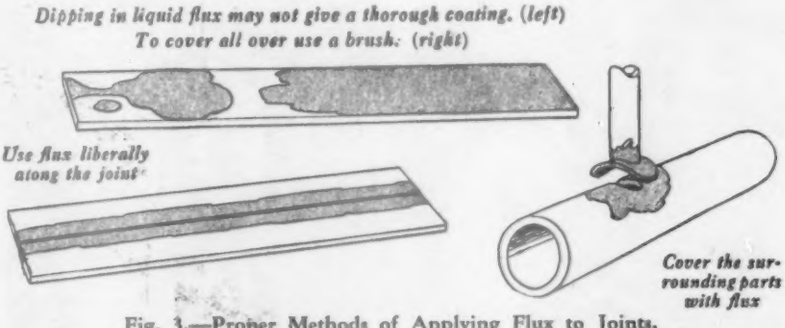
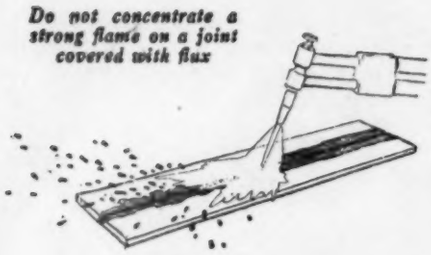

Dipping in liquid flux may not give a thorough coating. (left)
To cover all over use a brush. (right)
Use flux liberally along the joint
Cover the surrounding parts with flux

Fig. 3.—Proper Methods of Applying Flux to Joints.

(Too much care cannot be expended on applying flux. Its correct application will mean the difference between a good and a poor soldering job.)



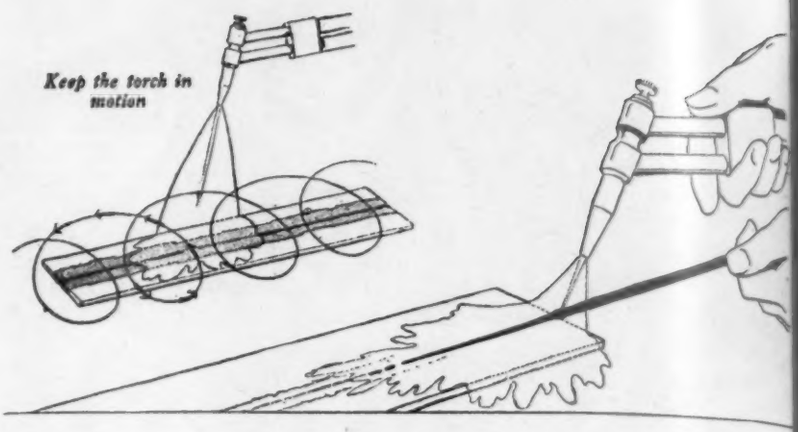


Fig. 4—(Left and Center).—Incorrect and Correct Methods of Applying Flame To Silver Solder.

Fig. 5. (Right.)—Applying Silver Solder After Pre-Heating.

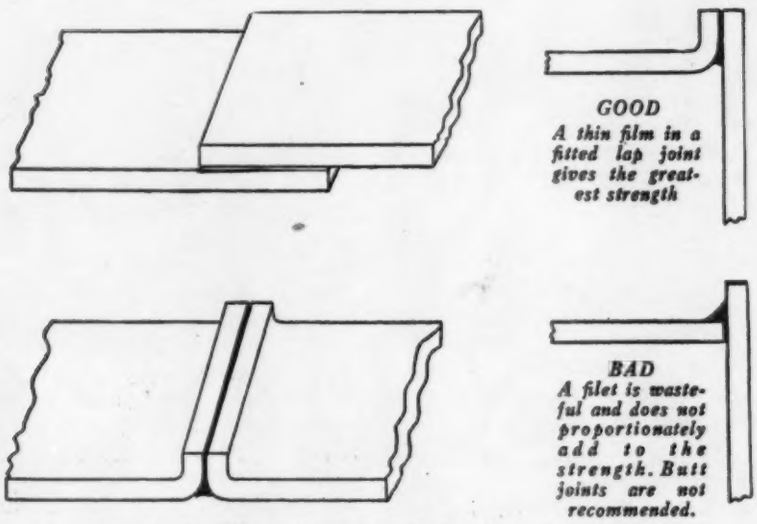

GOOD
A thin film in a fitted lap joint gives the greatest strength
BAD
A filet is wasteful and does not proportionately add to the strength. Butt joints are not recommended.

Fig. 6.—Lap-Shear Joints Are Preferable to Butt Joints.

is less tendency for the heat to radiate away from the joint itself. Keeping the flame in motion, and uniform heating, insure the production of the required temperature over a sufficiently large area to avoid overheating (see Fig. 4). This is particularly true of copper, which is a rapid conductor of heat. When preheating two different kinds of metal, favor the metal that is the more rapid heat conductor. For joining pieces of unequal thickness, the heavier piece should be thoroughly preheated.

When the joint is sufficiently hot, as can be judged by the color of the metal itself, and slightly above the melting temperature of the solder or brazing alloy used, the silver solder is flowed into the joint by permitting the heat of the joint to melt it.

In brazing, certain precautions should be observed. Since the operator must judge the correct heating temperature, preparatory to flowing on the solder, by color, he should not permit light conditions to distort his judgment. He should not face the light and he should also shield the work against light and air drafts. The latter often cause uneven cooling.

Silver soldering is much faster than welding. Therefore the tip of the luminous flame should be played in a circular motion close to the joint, quickly melting the solder into place. In Fig. 5 correct methods of applying solder are

Fig. 7. (Left).—Brazing End Plates to Copper Bellows in Regulator Valve.

Fig. 8. (Below).—Two Herculoy Tanks Brazed With Silver Alloy Having Melting Point at 1300° F. No Flux Used. These Have Withstood Corrosive Action in a Chemical Plant For Two Years.

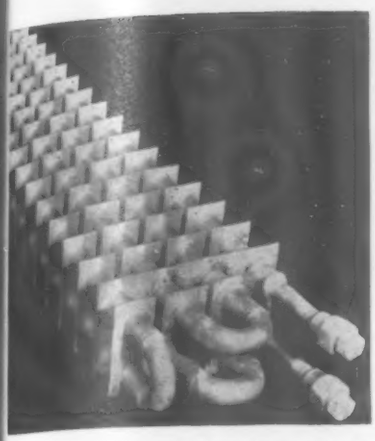


Fig. 9.—Brazed Copper Pipe Return Bends.
(The joints were heated to 1300° F. and touched with silver brazing alloy, which penetrated fully.)

Fig. 10.—Bronze Sections of Ornamental Lamp Posts.

(Sections prepared for brazing, and actual brazing operations are shown. Before using silver solder on this work, the producer tried without success to braze with spelter. This was abandoned because of the high heat conductivity of the casting.)

shown, and in Fig. 6 are shown the advantages of lap joints over butt joints.

A few representative brazing jobs will help to indicate the variety of successful applications of silver brazing alloys.

Wide Range of Silver Brazing Alloys Can Be Used With Copper

Copper.—In brazing this metal, there is a wide range of silver alloys that can be used, well within the 1981° F. melting point of copper. However, because of the rapid heat conduction characteristics of copper, it is advisable to use silver alloys melting at low temperatures, particularly where applied to thin sheet sections and tubing, thereby avoiding overheating and excessive grain growth.

A good example of brazing thin sections is shown in Fig. 7. Here thin end plates are being brazed to copper bellows for use in regulator valves. A patented silver brazing alloy containing silver, phosphorus and copper, melting and working easily at 1300° F., is used. It flows freely into the metal, actually alloying with it, making tight, permanent joints.

Fig. 8 shows two large tanks, 92 in. outside diameter and 72 in. inside depth, made of 3/16-in. half-hard copper. In this case, a thin ribbon of the brazing alloy was inserted between the overlapping tank seams. The seams then were riveted together, and when the heat from the brazing torch was applied, the sheets were joined solidly together. Because of the self-fluxing action of the particular brazing alloy used, no flux was necessary, as is frequently the case in joining copper to copper. These tanks have been in service in a chemical plant for about two years under corrosive conditions and have stood up remarkably well.

In brazing a copper distillery heater, a 7-ft. 10-in. seam, extending the full heater length, and 6-in. inlet and outlet connections were brazed in only 1½ hours. The manufacturer reports that doing the same job with spelter would have taken a full working day.

Fig. 9 shows refrigerator cooling coils of copper, with the pipe and return bends of the same diameter. The pipe ends are flared to admit the bends in a simple "light push fit." The fitted pieces are heated with the small tip of a moving oxyacetylene flame and, when a temperature of 1300° F. is reached, the brazing alloy is touched to the edge of the joint. At this temperature the solder penetrates fully into the lapped area.

Silver Solders Succeed With Bronze After Spelter Fails

All the jobs thus far described were made with a brazing alloy melting at approximately 1300° F.

Bronze.—Fig. 10 shows a brazing operation on "government bronze" casting segments, being joined to form sections for ornamental lamp posts. Other segments are joined to form "rings" or irregular shapes. Before using silver solder, the producer tried unsuccessfully to braze with spelter, but gave it up because the rapid heat conductivity of the casting at the temperature required for the operation made proper joining of the segments impossible.

Iron and Steel.—Silver brazing alloys can be used to join iron, steel and stainless steel, in sheet or strip, to similar metal or to non-ferrous metals. Where a ferrous metal must be joined to a non-ferrous metal, the use of low-melting silver solder is desirable to keep well below the melting range of the latter class of metal. Base-metal brazing solders do not offer such insurance because of their higher melting range. An ex-

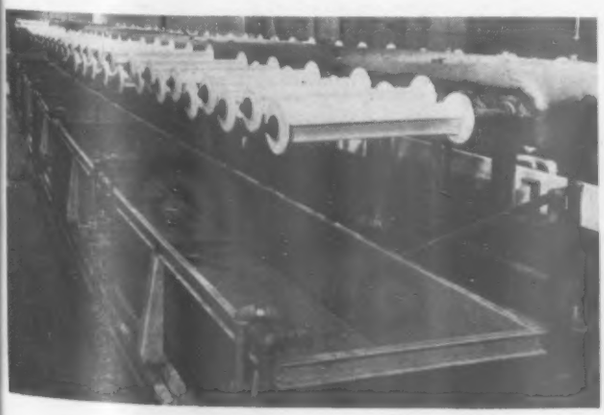


Fig. 12.—Silver Soldered Monel-Metal Tank.

(The lock-seam joints of this tank, with its heating coils, partitions and outlets, were all silver soldered.)

ample of brazed stainless steel is shown in Fig. 11. A silver brazing alloy melting at 1175° F. was used to join two wire screens at the outer edge to a solid ring. The strainer thus produced is strong and corrosion-resistant throughout.

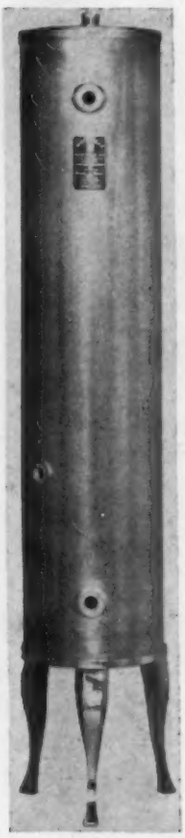


Fig. 11 (Above).—Brazed Stainless-Steel Strainer.

Fig. 13. (Left).—Monel-Metal Tank With Silver-Soldered Fittings.

Nickel and Monel Metal.—For brazing these metals silver solders offer decided advantages because of their low flow points and general ability to withstand corrosive conditions for which nickel or monel metal is often used. Compared with soft solders, they often are not only more corrosion-resistant, but possess greater strength under fatigue stresses. It has been pointed out by the manufacturers of monel metal that where considerable vibration exists, as in dye tanks when the incoming jet of steam heats the bath, silver-soldered lock-seamed joints withstand the shock satisfactorily. Fig. 12 shows a Buhlmann type skein-dyeing machine equipped with a 52-ft. monel metal tank, heating coil, partitions and outlets. All lock-seamed joints are silver soldered.

Copper, Everdur and Monel Metal Brazed With Silver Alloys

Silver alloys are widely and very satisfactorily used in attaching fittings or spuds to sides and heads of copper, Everdur and monel-metal boilers, hot-water storage tanks, etc. For such work (see Fig. 13) a washer or ring of the silver alloy is inserted between the spud and the tank and the entire assembly is clamped tightly in a jig. Heating the spud and surrounding metal with the oxyacetylene torch causes the solder to flow evenly, bonding the two metal parts into a strong, leak-proof joint that is attractive in appearance.

Silver solders and brazing compositions in use today are the result of long study and research in not only their development but also in the recommendations that have been evolved as to the use of fluxes, cleaning methods, and types and uses of torches and furnaces as applied to various kinds of metals and alloys. Such metallurgical research and improvement will go on in an ever-widening scope.

Upon the workman, however, rests the responsibility of closely following a few simple principles and making the use of these versatile brazing alloys a true art in metal fabrication.

Strengthens Milwaukee Viaduct by Welding

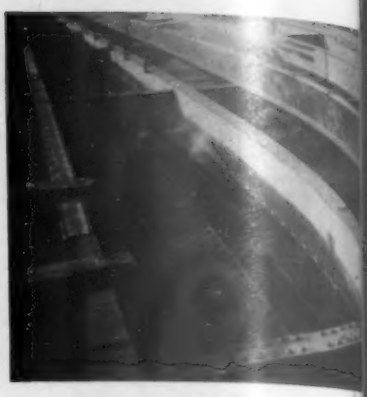
By A. H. FRIESE
Welding Engineering Company

The city of Milwaukee, Wis., is widening the top of the 27th St. viaduct in that city and also reinforcing the main lengthwise 18-in. I-beams to meet modern traffic requirements. In this work, a great amount of welding is being used.

There are four of these main beams, each approximately 2,700 ft. long, running the length of the viaduct. Altogether, approximately 13,000 ft. of welding will be required.

Both top and bottom of these beams are being reinforced with ⅜-in. plates, the top plate being narrower than the top flange of the I-beam and the bottom plate being wider than the bottom flange, thus allowing all welding to be done in the downhand position, except at the ends of the under plates, where overhead welding is required. Intermittent welds are used, and two operators weld on both sides of the same plate at the same time, thereby eliminating buckling of the plate and facilitating the welding operation.

All plates are held in place on the top and lower flanges of the beams by means of special clamps of such a design as to allow speedy manipulation when either closing or opening. Shielded-arc electrodes are used. Short I-beam sections for supporting the street-car rails are also being welded in place on the floor beams.



Reinforcing Plates Welded on Beam Flanges With Intermittent Welds.

Portable 4-wheel trailer pneumatic-tired welding machines are being used, each equipped with a 50-ft. ground and 100 ft. of electrode cable.

The viaduct was closed to traffic on June 2, and the work is expected to be completed by October.

St. Louis Firm to Build Twelve Welded Barges

The Dewey Portland Cement Co., Kansas City, Mo., has awarded a contract for 12 all-welded barges, for hauling coal on the Missouri River, to the Shipbuilding & Steel Co. of St. Louis, Mo. This is one of the largest orders ever placed for all-welded coal barges and it is understood that delivery is to be started in ten weeks.

These barges are 190 ft. long, 35 ft. wide and 10 ft. deep and are the largest type of all-welded coal barges made. They will require 2,600 tons of steel plates and shapes. The order, when completed, will make the Dewey fleet one of the largest for coal handling in the United States.

Wire fences of welded constructed are particularly desirable for enclosing livestock because the absence of wraps or ties in the wire reduces the danger of scratching the animals.

Main Beams of Viaduct With ⅜-in. Plates Clamped in Place.

Get "H. O. T." on Welding

By H. O. T. RIDLON

Salute to a Friend!

Progressive Eddie Scott, the swell ...nt that runs the Cleveland School of ...elding out Cleveland way, gets the ...mp again. Eddie has always been ...r sighted by giving his boys those ...ings that they are apt to run into in ...dustry after they have left his shelter-...g wing and gone forth into the world ... seek fame and fortune as welders. ...me get pretty far and others seem to ...lways manage to get bacon and beans ...ecause Eddie puts the stuff out in a ...y that will help any kid that really ...ants to learn.

Now this metal spraying, or metallizing, or whatever you wish to call it, has been having its ups and downs for the last few years and now, like water, is finding its own level, or place in the sun or something, and industry is turning to the welder to operate this machine, because he is the gent in the plant who knows all about the oxyacetylene flame, regulators and such.

So "Scottie," as he is affectionately called by those that know him, saw the hand-writing on the wall and went to great expense to install a complete metal-spraying outfit with compressor, spray booth, gun, sand-blast equipment and all the things that go with it.

Nice eye, my friend. I like to see things like this that help our young hopefuls, because there are too many so-called welding "schools" that are no more or less than rackets.

• • •

A Hot Spark

Brains are fairly common, but the use of them is rare!

• • •

More About Education

Today was a sad and yet a pleasant one for me. It was spent behind the walls of a reformatory with a friend of mine whose job is supervisor of education of that institution. We were planning a welding school for these boys.

The average age of the boys in this institution is about 25. They are all of the better type, as they express it, because most of them are better than the usual trusty class. Most of them are there because of lack of education and environment. It is hoped that when these men are discharged they will have received enough training and education so that they will be able to carry on alone and keep their noses tidy. It is really a grand job these officials are doing.

There is a swell chance for someone who can teach welding and adjust himself to the work, to get himself a nice, steady job, learn a lot, and do a great deal of good, as welding instructor there. I have been asked to help them find a man for this job, so if you are interested or know someone that wants to get on Uncle Sam's pay roll to start at the rate of $2,000.00, write to me all about yourself, and if you look like a possibility I'll pass your name along and you'll then hear from the institution direct. Address me at 200 Park Ave. West, Mansfield, O.

But you have to have something of an education and be able to stand on your hind legs and talk. You must be able to keep records and do paper work. And then, of course, there are other qualifications for a job like that, so that the guy that gets it is really quite a lad. Age one way or the other doesn't seem to be a drawback if you've got the stuff and know how to strut it.

Don't get me wrong; I know that very few people would want this job, but somewhere there is just the right guy to fit into this picture, and I hope my friends will help me find him, because it is, I believe, up to all of us to help these poor mugs get started on the right foot so that they will be a credit to the industry should they follow the welding trade after their discharge.

• • •

Show the Plumbers Your Stuff

It seems that business is picking up. Yes sir, there are real signs all along that things are much better. I've even heard that we have finally gotten around that corner we heard so much about last year. And among the things that are getting going is building and repairing of homes and buildings. And it seems that Old Joe Public in many cases is getting pretty smart, and when it comes to the water pipes, he's figuring on brass or copper; anyway, something that will last longer and give less trouble should another depression sneak up on him some morning. The idea being it's going to cost more now but will be cheaper in the long run. And really the way to put these pipes together right is with that good old pal of ours, the oxyacetylene torch, using as a filler rod some soldering or brazing alloy that melts at a relatively low temperature. Get wised up on this trick and let the plumbers around your neck of the woods know you're up on your stuff and can help them put in that kind of an installation any time they get one. Make up a few small samples and get one to each of them so that they can show their customers how neat a joint can be made this way.

Some Building!

Speaking of companies that believe in their own stuff, it really is a treat to see that new building here in Mansfield that Westinghouse is putting up. By the great downtown, now there's a building, and are they doing welding in putting that bring together!

• • •

Jimmy Bradshaw, that smiling gent who spent so many years selling oxygen, acetylene and equipment around Cleveland and then went down East to do battle in the Bronx, is returning, I understand, for a few months at least, to his old stamping grounds. It's my bet that all the girls and boys will be glad to see Jimmy come home.

• • •

The thought for the month: What I spent, I had; what I kept, I lost; what I gave, I have.

• • •

P. S.—The support, in cash, of the Fusion Party so far is nil.

Cross-Country Pipelines To Be Gas Welded

Oxyacetylene welding by the Lindeweld process will be employed on a number of new pipelines, according to The Linde Air Products Co., 30 East 42nd St., New York, N. Y. One of these is a 178-mile line being built by Williams Brothers, of Tulsa, Okla., for the White Eagle Division of the Socony Vacuum Oil Co., which will carry gasoline between Augusta, Kan., and Kansas City. The other lines are shorter and comprise a 30-mile 6-in. oil line near Hutchinson, Kan., being built by the Osage Construction Co. to increase the oil-moving facilities of the Stanolind Pipe Line Co. in that region; a 4-mile 4-in. gas line being laid in the vicinity of Russell, Kan., by the Knupp Construction Co. for the Drillers Gas Co., of Wichita; and approximately 15 miles of field lines in the vicinities of Dumas, Tex., and Hugoton and Liberal, Kan., to be laid by the J. R. Stewart Construction Co. for the Panhandle Eastern Pipe Line Co.

San Francisco Section Elects Officers

Though somewhat delayed, the announcement has come of the recently elected officers for the San Francisco section of the American Welding Society for the ensuing year. They are: E. L. Mathy, chairman; Prof. N. F. Ward, vice-chairman; J. G. Bollinger, secretary and treasurer; and Prof. N. F. Ward, chairman of the Program Committee. No meetings will be held during the summer. Activities will be resumed in September.

Comparative Economies *of* Metal Electrodes . . .

II—Bare Electrodes

(Second of Three Articles)

By KARL MELLER

THE results of tests with various current values on a bare electrode of 4-mm. diameter are illustrated by the curve in Fig. 2, which shows a straight-line relation between the rate of melting and the current up to a certain point, within practical current values. For instance, at 150 amperes, the melting rate is 1.3 kg. per hr. (2.87 lb. per hour), and at 300 amperes 2.4 kg. (5.29 lb.) is melted per hour. Hence, the rate of melting increases with the current, though not proportionally. Since it stands to reason that the total cost of a weld depends on the quantity of electrode consumed within a fixed period, the conclusion is justified that welding should be done with as high a current as possible.

The question now arises, whether the current can be increased indefinitely, or whether there exists a certain limit. Every practical welder knows that when a certain maximum current is exceeded, the electrode begins to glow over its entire length, the flow of the molten metal becomes unsteady, and the welding qualities are impaired to a considerable extent. In Fig. 2, with a 4-mm. electrode and about 350 amperes, the curve deviates from the straight line and the melting rate increases more rapidly. Tests were applied to similar electrodes, having diameters of 3 and 5 mm., for the purpose of finding out whether such deviation is a regular phenomenon occurring also with electrodes of other diameters.

The curves in Fig. 3 reveal that with an electrode of 3-mm. diameter, deviation sets in when a certain current value is reached, but this is not the case with a 5-mm. electrode up to 500 amperes, which was the maximum current that could be utilized. The question now arises as to what causes such deviation of the curve. A calculation of the results shows that deviation takes place with the 3-mm. and the 4-mm. electrodes when subjected to a specific current density of about 29 amperes per sq. mm. (17,700 amperes per sq. in.). Further, there is a certain conformity in the welding properties of the electrode insofar as this specific load marks the upper limit at which satisfactory welding is possible.

Melting Rate Is Fairly Constant for All Electrode Diameters

The assumption that this limit depends solely on the specific capacity of the electrode is erroneous. Tests show

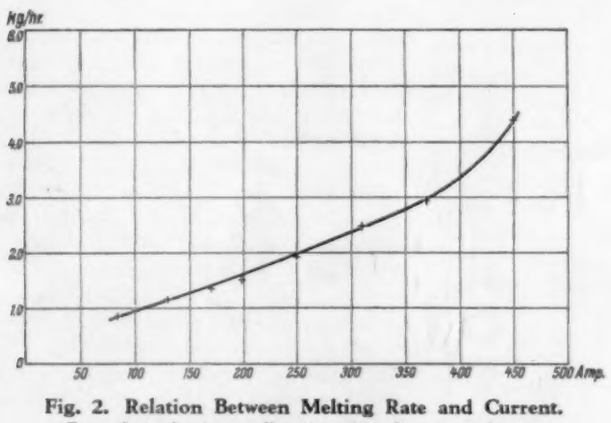


Fig. 2. Relation Between Melting Rate and Current.
(Bare electrode, 4-mm. diameter; 11 volts across the arc.)

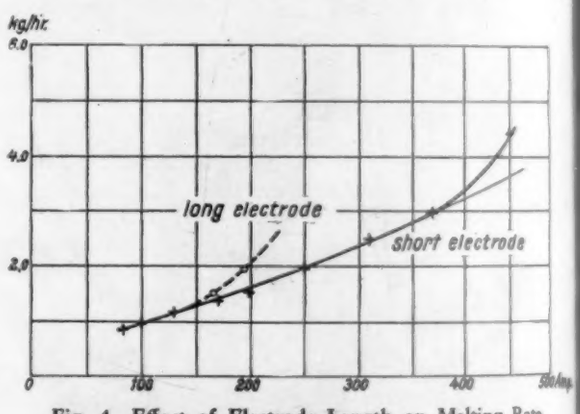


Fig. 4. Effect of Electrode Length on Melting Rate.
(Broken line represents electrode held at the end, and solid line represents electrode held in the middle.)

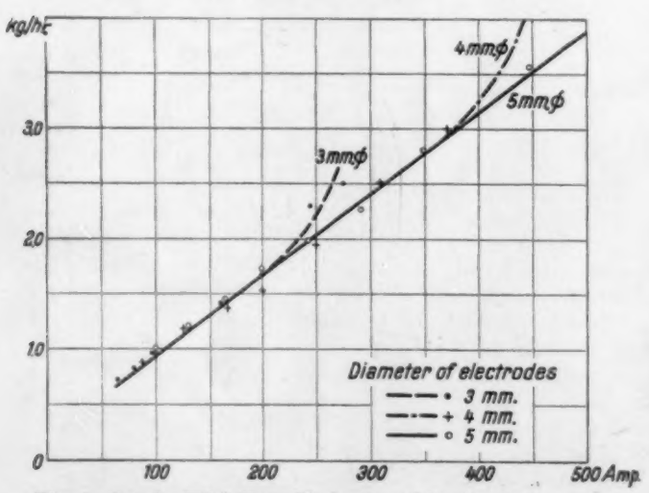


Fig. 3. Results With Bare Electrodes of Various Diameters.

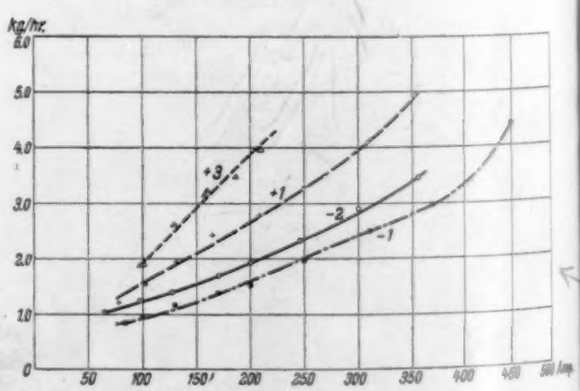


Fig. 5. Melting Rates of Various Bare Electrodes.
(The three different types of electrodes are numbered, and positive polarity is indicated by a plus sign and negative polarity by a minus sign.)

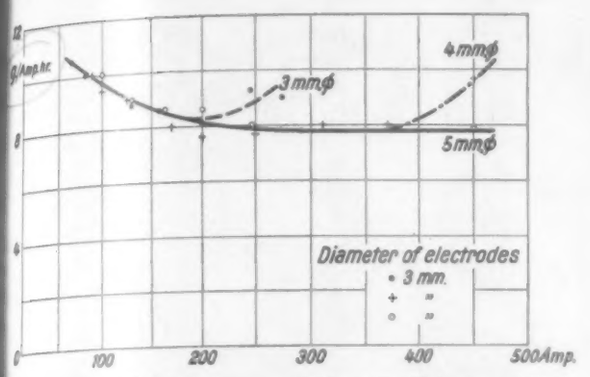


Fig. 6. Effect of Diameter on Melting Coefficients of Bare Electrodes.

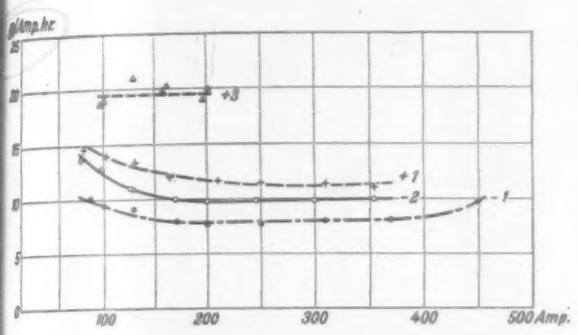


Fig. 7. Melting Coefficients of Various Types of Bare Electrodes.

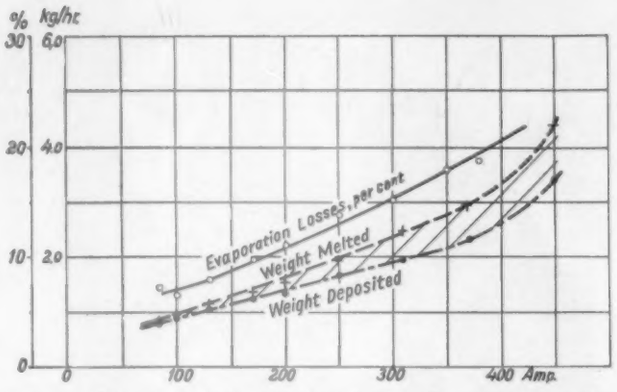


Fig. 8. Weight Melted, Weight Deposited and Evaporation Losses of Bare Electrode of 4-Mm. Diameter.

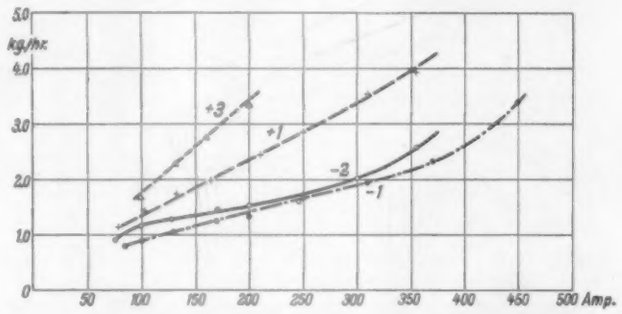


Fig. 9. Weight Deposited per Hour for Various Types of Bare Electrodes.

(The three different types of electrodes are numbered, and positive polarity is indicated by a plus sign and negative polarity by a minus sign.)

that the deviation of the curve depends to a marked degree on the clamped length of the rod. This is confirmed in manual-welding practice, since when electrodes of the same diameter are clamped in the center they can carry a higher current than when clamping is at the end. To obtain some definite data on this question, the melting tests were repeated, but the free end of the wire, which in the tests in Fig. 3 was only 30 to 40 mm. (1.18 to 1.57 in.), was lengthened to 400 mm. (15.7 in.). This resulted in a material decrease of the highest permissible current value, and, in consequence thereof, in a much earlier deviation of the curve, as shown in Fig. 4. But Figs. 3 and 4 show plainly that within the permissible load of the electrode the melting rate, being dependent on the current, lies practically on a straight line and that, therefore, it is not affected by the electrode diameter.

Polarity Has Pronounced Effect on Rate of Melting

This curve is different for each type of electrode, and, moreover, is affected by the polarity used. Fig. 5 shows how with the same electrode the melting rate depends on the polarity. For instance, with electrode *1* and 200 amperes, the value increases from 1.5 kg. per hour (3.31 lb. per hour) with negative polarity to about 2.7 kg. per hour (5.95 lb. per hour) with positive polarity.

The curves in Fig. 5 also show that with positive polarity the melting rate depends on the type of electrode. Electrode *3* is a special wire for build-up work, and has about 1% carbon and 12% to 14% manganese. With this wire the melting rate is about three times as high as with ordinary welding wire used with negative polarity.

Melting Coefficients Vary Only Slightly With Any Given Electrode

The diagrams so far shown disclose the dependence of the melting rate, in kilograms per hour, on the current in amperes. But the rate of melting may also be expressed in grams per ampere-hour, as shown in Fig. 6, which represents electrode *1* with negative polarity. It will be noticed that the rate of melting in ampere-hours varies at low current values only, and remains almost uniform over the working current range, except the deviation occurring with unduly high currents. The curves in Fig. 7 pertain to bare electrodes with different polarities. As these values change but little over the entire current range, the weight of electrode melted per ampere-hour may be adopted as the melting coefficient for that particular type of electrode. Such a coefficient, if specified, would designate the electrode.

Unfortunately, that entire portion of electrode melted is not fully utilized, a certain part thereof being lost by spattering, evaporation, etc. Fig. 8 shows the result of a measurement of a bare electrode. The losses are represented by the distance between the two broken curves (quantity melted less deposited quantity). Within the range of 150 to 250 amperes, they amount to about 8% to 12% and increase further with increasing currents. An examination of comparative specimens indicates that quite likely build-up welding will show the highest losses, but the losses are somewhat less when welding with several layers or with fillet welds.

In computing the cost of labor, the weight deposited per unit time is the deciding factor. Fig. 9 shows the relation between current and rate of deposit for electrodes *1*, *2* and *3*, taking into account the losses caused by spattering, etc.

Actual Arc Voltage Is Appreciably Lower Than Generally Assumed

The tests so far described were made with a constant arc potential of about 11 volts. In what follows will be shown how the former results are influenced by varying the arc voltage—that is, by the length of the arc. At the very start, the tests disclosed that in actual practice a certain confusion and erroneous conception prevailed with regard to the value of the arc voltage. The latter is, in fact, appreciably lower than is generally assumed as indicated by the voltmeter at the welding set. This is due to the fact that the meter reading is the sum of the arc voltage and the voltage

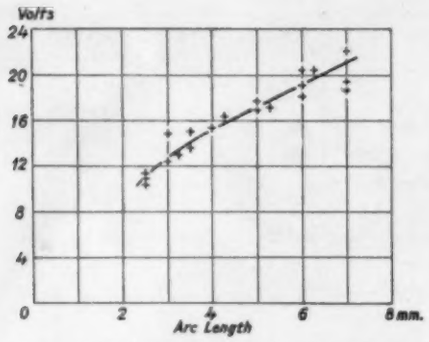


Fig. 10. Relation Between Arc Length and Arc Voltage.
(Bare electrode, 4-mm. diameter; 170 amperes.)

drop in the wire, the contact resistance and the work pieces and cable.

For example, with ordinary hand welding at 150 amperes, using 20 m. (65.6 ft.) of cable having a sectional area of 50 sq. mm. (0.077 sq. in.), there was a 3-volt drop in the cable itself. This value is by no means abnormal; in fact, it increases with higher currents; and in welding 6-mm. electrodes, for example, with a current of about 260 amperes, the total drop would be about 5 volts, owing to the increased voltage drop in the cable and in the joints. Very often such losses are entirely disregarded or their magnitude is greatly underestimated.

Small Voltage Drop in Arc Circuit Means Considerable Power Loss

With an arc voltage of 12 to 14 volts, a voltage drop of 3 volts would result in a loss of about 25%, and a 5-volt drop would represent a loss of about 40% of the total power in the arc circuit. This shows that too much weight can be given to the efficiency of welding sets, since a difference of 2% or 3% is practically without any consequence in comparison with the total losses.

In order to determine the relationship between the length of the arc and its voltage, a series of separate tests was carried out. The image of the arc was projected on a screen through a lens with a tenfold magnification, 1-cm. arc length on the screen thus corresponding to 1-mm. actual arc length. The length was measured during the actual welding operation. Since the arc length changed continually during welding, a great many measurements were made for determining average values. The results of such measurements for a welding current of 170 amperes, with bare electrodes of 4-mm. (0.157-in.) diameter, are shown in Fig. 10. It will be noted that the arc length varies from 2 to 6 mm. (0.079 to 0.236 in.) through a voltage range of 10 to 20 volts. With constant voltage, any increase in current requires a corresponding increase in arc length. Therefore, the position of the curve in Fig. 10 shifts to the right with increasing current.

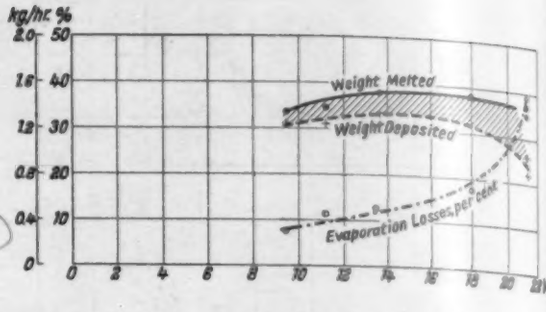


Fig. 11. Rates of Melting and Deposition, and Evaporation Losses, at Various Arc Voltages.
(Bare electrode, 4-mm. diameter; 170 amperes.)

Fig. 11 shows the rates of melting and depositing electrode metal, also losses for a certain electrode, obtained with varying arc voltage, but with a constant current of 170 amperes. It will be noted that the melting rate is practically independent of arc voltage. The lower values obtained at decreased arc voltages result from the fact that the number of short-circuits grows with the reduction of the arc length, as disclosed by oscillograms, so that the actual burning period of the arc is reduced within the same unit of time.

Voltage Has But Slight Effect on Weight of Electrode Deposited

The losses increase with increasing arc voltage. It should be borne in mind, however, that high losses at high voltages are of no consequence in practice, since with bare electrodes the arc voltage ranges between 11 and 15 volts. If the losses are deducted from the weight melted, we obtain the deposit weight shown by the middle curve in Fig. 11, these values being practically constant over the practical voltage range, but dropping at the higher voltages because of increasing losses.

Frequency of Short-Circuits Is Greater at Higher Voltages

The oscillograms in Fig. 12 show the conditions occurring at various voltages. The decreasing number of short-circuits at higher voltages will be clearly noted, and it is also evident that practically no short-circuits occur beyond a certain voltage or arc length.

IN interpreting the illustrations in this article, the reader is cautioned to observe that the "arc volts" represent the actual voltage across the arc, which is somewhat less than the voltage reading across the generator terminals.—Editor.

In Fig. 13, the upper curve shows the percentage of total welding time occupied by the actual burning of the arc. For example, with 12-volts arc voltage, the arc is maintained during about 82% of the total time, while 18% of the time is taken by short-circuits. At 20 volts, practically no short-circuits occur under the test conditions. The mean duration of the individual short-circuits was also ascertained, and the remarkable fact was observed, as disclosed in Fig. 13, that the mean duration of a short-circuit is independent of the voltage, and is about 10 milliseconds. This

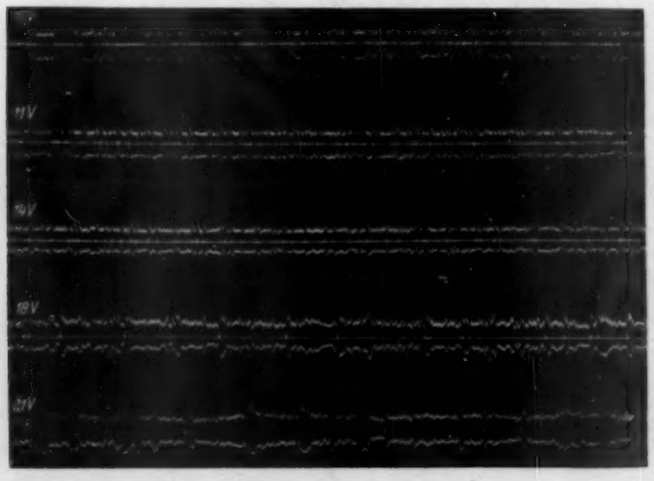
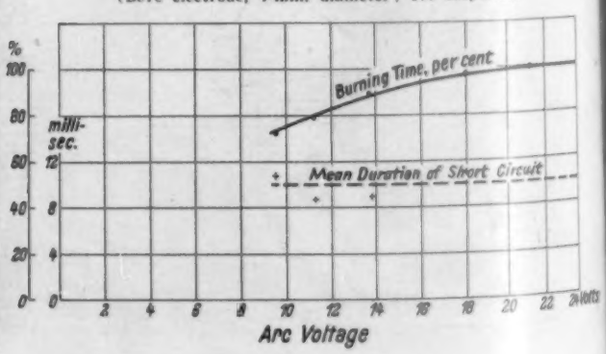


Fig. 12 (Left). Oscillograms Taken During Welding With 4-Mm. Diameter Bare Electrode, at 170 Amperes, With Various Voltages.

Fig. 13 (Below). Burning Time of Arc and Mean Duration of Short-Circuit as Affected by the Voltage.
(Bare electrode, 4-mm. diameter; 170 amperes.)



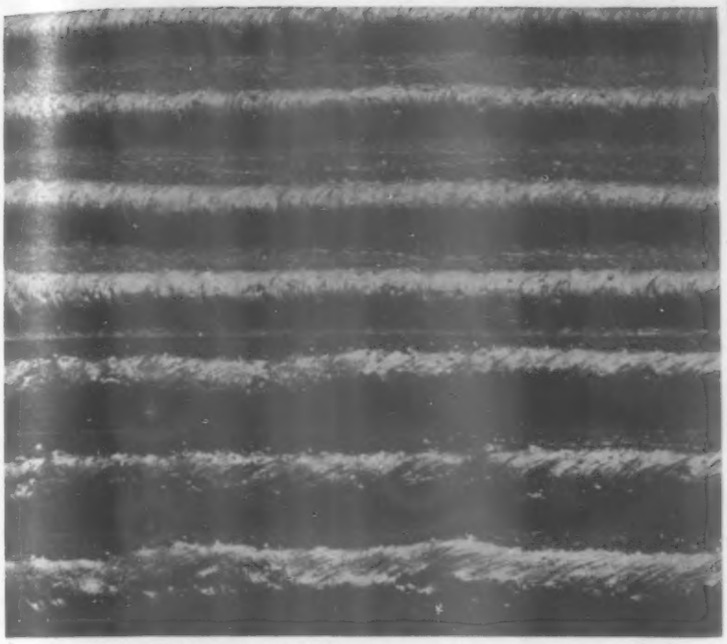


Fig. 14. Weld Beads of 4-Mm.-Diameter Bare Electrode Made With Various Currents.

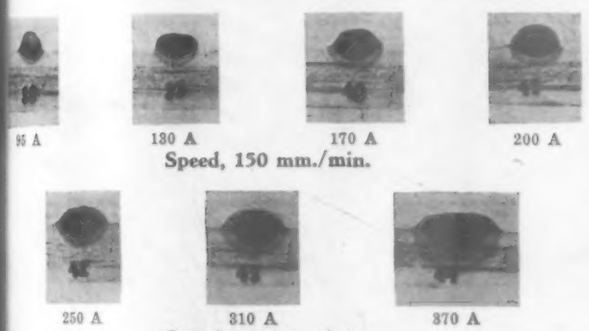


Fig. 15. Penetration of 4-Mm.-Diameter Bare Electrode Welded With Various Currents.

leads to the conclusion that though the duration of the short-circuit is very nearly constant, there is some variation in the volume of the drop transferred.

The observations made so far show that it is desirable, for economic reasons, to use electrodes having a high deposit coefficient and, in addition, to employ as high a current as possible. To what extent the current might be increased would have to be determined by further tests on the influence of current and voltage values on welding qualities. The preliminary tests show that there surely exists an upper limit of permissible current.

Current Density Affects Weld Quality and Appearance

Although the outward appearance of the seam does not permit of conclusively judging the quality of a joint, it is nevertheless thought appropriate to show in Fig. 14 the beads welded with various current values at low voltage, and at about the same speed and with a short, free length of the electrode. Judging by the appearance of the seam, one would consider the seam welded with 200 amperes as being quite satisfactory, while with currents exceeding this figure the quality of the seam might be doubtful. However, the cross-sections shown in Fig. 15 also reveal a satisfactory structure under high current densities.

It is further apparent that penetration and the affected zone of the material will increase with increasing current density. Some tensile tests made with specimens welded at high current densities showed very good and consistent results. It seems advisable, therefore, when making tensile tests, to pay more attention to the current density than heretofore.

Voltage Influences Form of Bead and Penetration

The influence exerted by voltage also does not appear to have been sufficiently cleared up. Fig. 16 shows weld beads made with various voltages, and also at 170 amperes. In this case, too, the voltage was varied over a wide range, this method being best suited for determining the fundamental influence exerted by the arc length, although in practice high arc voltage is not practicable for bare electrodes. The influence of voltage on the form of the bead and on the penetration is clearly shown in Fig. 17.

Since penetration can best be judged in the case of a fillet weld, such seams also were welded with various voltages. In Fig. 18 are shown beads which were welded with 10, 14, 17 and 22 volts. Sections of these beads, illustrated in Fig. 19, clearly show that at 10 volts there is almost no penetration whatever, while the reinforcement of the bead is very pronounced. The penetration increases and the reinforcement decreases with increasing voltage. At 22 volts, the penetration and the shape of the bead resemble those obtained in using covered electrodes.

Since covered electrodes are used with considerably higher voltages (about 20 to 25 volts), the assumption that the

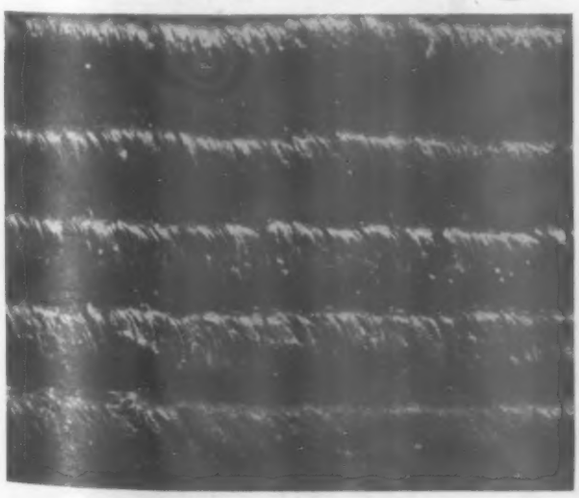


Fig. 16 (Left). Weld Beads Made With Various Arc Voltages.

(Bare electrode. 4-mm. diameter. Speed, 125 mm./min. Current, 170 amperes.)

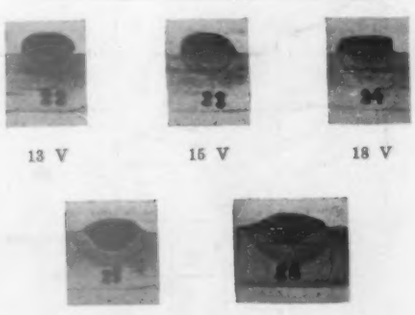


Fig. 17. Penetration at Various Voltages.
(Bare electrode, 4-mm. diameter. Speed, 125 mm./min. Current, 170 amperes.)

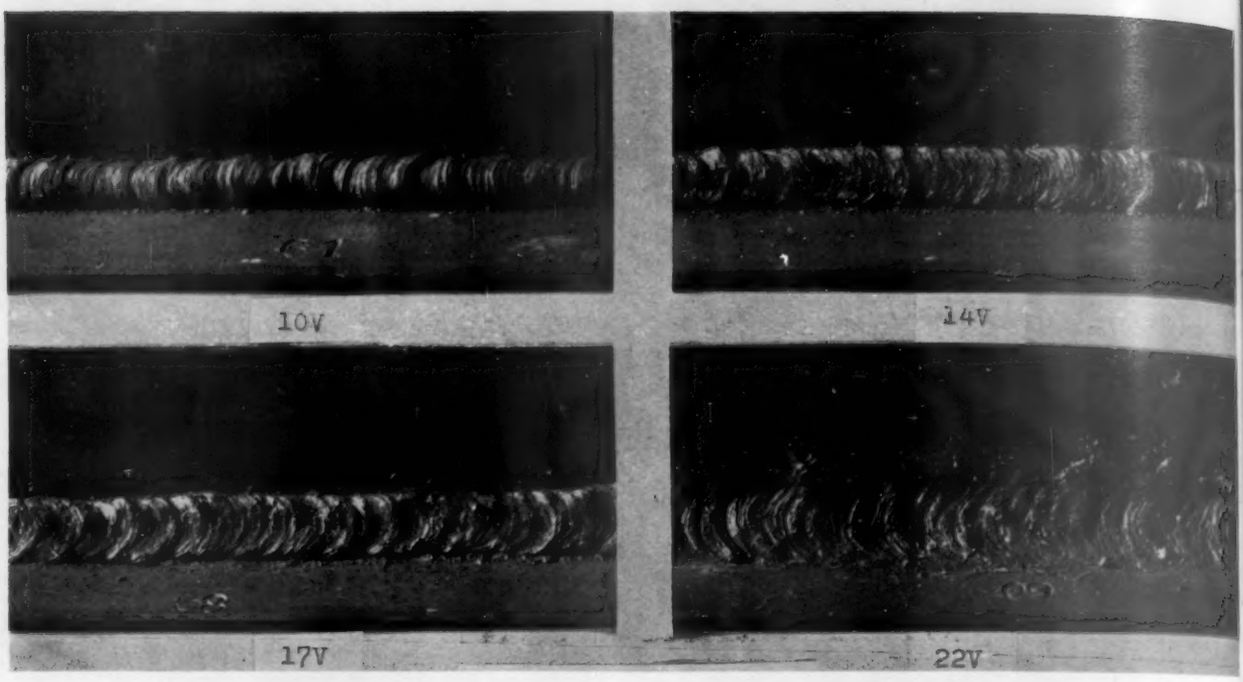


Fig. 18. Beads of Fillet Welds of 4-Mm.-Diameter Bare Electrode Made at Various Arc Voltages.
(Speed, 125 mm./min. Current, 170 amperes.)

shape of the bead is attributable, not to the covering, but to the higher voltage, may be justified. In order to avoid misconception, however, it should be pointed out that even with lower voltages but sufficiently high current, bare electrodes will also yield sufficient penetration, as may be seen from Fig. 15.

The fact has already been pointed out that the cost of welding is affected by the current consumption. Fig. 20 shows the power consumption of the arc, per unit weight of electrode melted in relation to the current, for bare electrodes of 3, 4, and 5 mm. (0.118, 0.157 and 0.197 in.) diameter and negative polarity. In this case these values show practically a constant power consumption—namely, about 1.4 kw.-hr. per kilogram. The value is somewhat reduced at very low currents, and increases at high currents. No law, however, could be established for this relation.

It has already been mentioned that additional losses will occur owing to the

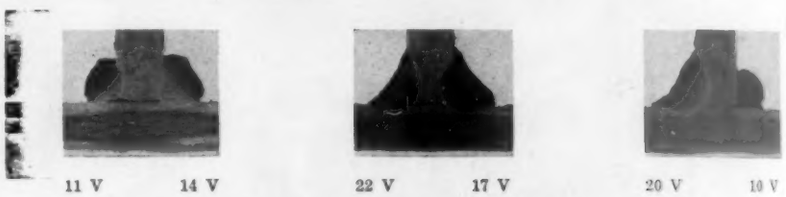
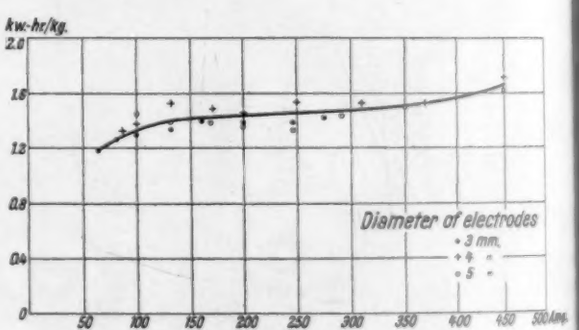


Fig. 19. Penetration of Fillet Welds at Various Voltages.
(Bare electrode, 4-mm. diameter. Speed 125 mm./min. Current, 170 amperes.)

Fig 20. Power Consumption of the Arc per Kilogram of Electrode Melted, Using Bare Electrodes of Various Diameters.



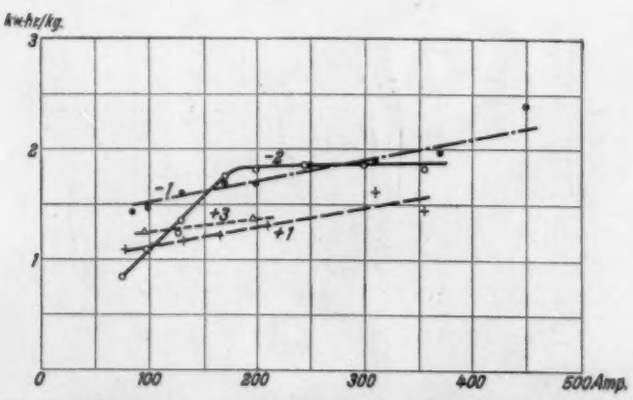


Fig. 21. Power Consumption Measured at Terminals of Welding Generator, per Kilogram of Electrode Melted.

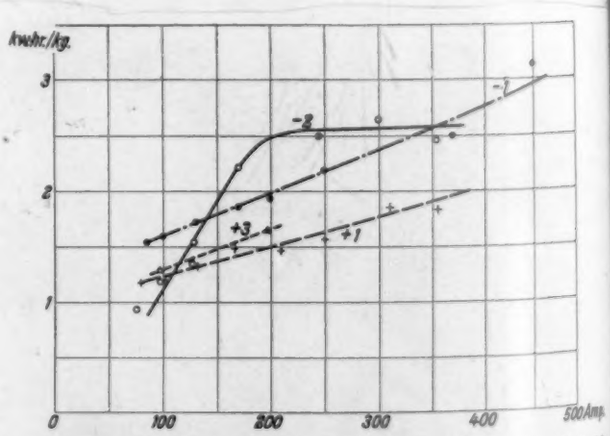


Fig. 22. Power Consumption Measured at Terminals of Welding Generator, per Kilogram of Electrode Deposited.

(The three different types of electrodes are numbered, and positive polarity is indicated by a plus sign and negative polarity by a minus sign.)

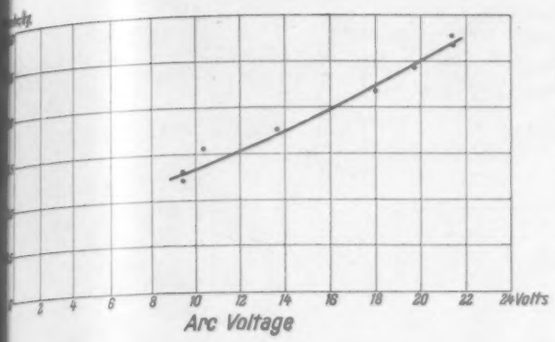


Fig. 23. Relation of Arc Voltage to Power Consumption of the Arc per Kilogram of Electrode Melted.

(Bare electrode, 4-mm. diameter; 170 amperes.)

tact resistances and cable losses. Fig. shows the power consumption per logram of electrode material melted, asured at the terminals of the weld- machine, for various types of elec- des and for positive and negative larity. The curves have an upward nd owing to the fact that the cable ses, etc. increase with the current. e losses occurring in the cables from terminals of the welding machine to external reactance, and in the re- tance coil itself, are disregarded here. e curve for electrode *2* differs from at of the others. This electrode is of e flux cored type. Whether this devia- on was due to an error in measuring some other cause, could not be ascer- ined by checking.

The power consumption per kilogram electrode material actually deposited still higher, as indicated by Fig. 22.

Determining Power Consumption for Manual Bare-Wire Welding

These values permit computing the ower consumption after taking into ac- unt the efficiency of the welding set nd the cable losses, the latter not hav- g been considered so far. If we assume welding-set efficiency of 50% and cable sses of 15%, these values will be mate- ially higher, averaging between 4 and 6 w.-hr. per kilogram (1.8 and 2.7 kw.-hr. er lb.), excluding the no-load losses. he latter will increase the values to ome extent, so that in practice, a con- umption of about 5 to 7 kw.-hr. per ilogram (2.3 to 3.2 kw.-hr. per lb.) of eposited metal can be taken. This was onfirmed by measurements.

These values apply, of course, only to re voltages met with in manual welding. ny lengthening of the arc, resulting in corresponding increase of the arc volt- ge, necessitates an increased power con- umption.

Fig. 23 reveals how the power con- umption per unit weight of deposit in- reases with the voltage for a bare elec- rode. The power consumption of the re increases approximately in direct atio with the voltage, and, in conse- uenee, the power taken from the mains ill also increase in proportion.

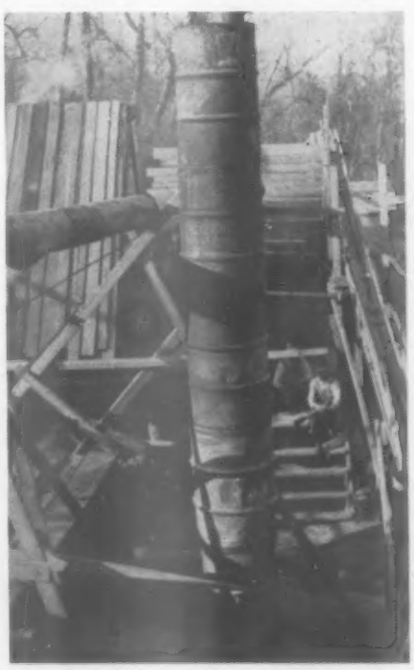
The question now arises as to what xtent a change in the individual factors iscussed will affect the total welding costs. It will be shown that electrode costs go up but immaterially with increasing current, notwithstanding the greater losses, and that the cost of wages is greatly diminished with an increase of current, and deposit coefficient. The reduction of labor cost with increasing current is all the more pronounced when labor rates are high. With the ordinary bare electrode, the labor costs exceed considerably the electrode costs. This difference becomes the more apparent, the lower the current and the smaller, therefore, the diameter of the electrode used. The difference will be even more marked if the incidental time losses are taken into account as well.

(Next month's article will deal with covered electrodes.)

Emergency Stack Made From Oil Drums

By ELTON STERRETT

When a miniature "twister" swept down to collapse a rust-eaten sawmill stack, it looked like an enforced shutdown until a new smokestack could be obtained. But the cross-roads garageman, equipped to make autogenous auto repairs and only a few miles away, had already pinch-hit with his welding torch on some machinery breakdowns, and so the problem of resurrecting the twisted and torn stack was put up to him.



This Saw-Mill Stack Replaced One Destroyed by a "Twister".

The old metal was found to be so badly rusted as to be beyond salvage, but with five oil drums—of the familiar 55-gallon type used universally for shipping petroleum products—the welder quickly fabricated a stack by cutting out the heads and joining the ends.

For more than three years this makeshift stack has stood; often heated to a cherry red through half its length and then quenched by a sudden downpour of rain, yet still the welds hold and the drum steel carries on. The boss sawyer "'lows as how" the improvised stack would probably outlast some of the machinery.

Bring the Ladies to the A. W. S. Cleveland Meeting

The Women's Committee in charge of entertainment for the women visitors at the Fall Meeting of the American Welding Society, to be held in Cleveland, Oct. 12 to 16, urges all those who will attend to bring the ladies with them. Entertainment is being planned for the five days, reports Mrs. Mildred H. Kinkead, chairman of the Committee.

Barge-Building Business Continues to Boom

A contract for the construction of a fleet of 10 all-welded steel barges for use in the movement of coal on the Ohio, Monongahela and Allegheny Rivers, has been awarded the Dravo Contracting Co., Pittsburgh, Pa., by the Keystone Sand & Supply Co., also of Pittsburgh. These carriers will be of the standard size, 175 ft. long, 26 ft. wide and 11 ft. deep, with a capacity of 1,000 tons each, and will require approximately 1,500 tons of steel plates and shapes.

The Dravo concern also will launch a new towboat, the *Charles T. Campbell,* for the Campbell Transportation Co., of Pittsburgh, at an early date. It is a sister ship to the *John W. Hubbard,* built for the same concern recently at a cost of more than $250,000, and there is considerable welding on it.

On July 1, the Dravo company had 31 vessels under construction at their marine ways on Neville Island on the Ohio River, about 12 miles below Pittsburgh. Included among them are one welded cattle barge, one welded oil barge, one welded towboat hull, four welded flush cargo box barges and seventeen welded coal barges. The concern is unusually busy at the present time and is enjoying the largest volume of business since the dark days of 1929.

A. P. I. Issues Specifications on Welded Storage Tanks

Tentative specifications on all-welded oil storage tanks have been issued by the American Petroleum Institute, Division of Production, Dallas, Tex , and copies are available at 75c each These cover design, fabrication and erection, and an appendix includes design data, a standard order form, and tests for qualifying welding operators.

Welding operations are limited to the electric-arc method, employing the shielded arc. In the preparation of the plate edges, the machine-operated gas torch can be used for cutting, but the edges must be freed of scale and slag accumulations before welding. The circumferential edges of the roof and bottom sketch plates may be cut with a hand-operated gas torch.

Joint efficiencies are taken care of by means of an efficiency factor (E) based on the type of joint. For example, double-welded butt-joints are allowed a factor $E=0.85$ for vertical joints, in computing the minimum thickness of the shell plates required, and single-welded butt joints with backing-up strip also rate a factor of $E=0.85$. On the other hand, joints having the plates lapped not less than $5t$, where t is the plate thickness and both edges full-fillet lap welded, will rate a factor $E=0.70$. The maximum plate thickness t for this type in a vertical joint is 7/16 in. Where the fillet on the outside of the tank is a full-fillet lap weld and the fillet on the inside is at least 25% intermittent, the joint factor $E=0.5\ k/5$, where k is the percentage of full-fillet intermittent welding, expressed as a decimal. At the purchaser's option, seal welding may replace the intermittent welding.

Holes made for erection purposes may be closed by driven plugs welded around their circumference, inside and outside, or these holes may be filled with driven rivets.

It is required that lap-welded horizontal joints in the shell plate be welded with a full-fillet weld on the outside (that is, on the top edge of the lower plate), and that the inside weld be at least 25% intermittent, with continuous welds for 6 in. on each side of vertical seams. All horizontal welds between shell and bottom plate, or along any intermediate bottom angle, shall be continuous.

Vertical lap joints in the shell plate are to have continuous full-fillet welds both inside and outside, except that when the plate thickness is not over ¼ in. the inside fillet weld may be at least 25% intermittent. For plates over 7/16 in. in thickness, butt joints must be used.

Further details are also given on the welding of the shells, bottoms and tops of tanks, including welding sequence, also design information and instructions on testing, inspection and repairing.

"Painless" Collection Series Pulls In the Cash

By FRED E. KUNKELL

"At times the question of collecting money from overdue accounts is like pulling teeth," says a welder. "One must be particularly watchful to keep his accounts paid up and liquid. Frozen assets prove embarrassing, if not fatal.

"Recognizing the importance of the situation, I sat down and evolved a series of collection letters which would turn the trick and keep customers smiling. I used subtle dunning epistles. I experimented until I had found those letters which would extract checks painlessly and would not loose the customer's good will and friendship.

"Then I numbered them in 1, 2, 3 order and had a girl in the office type and mail them out every week, on Friday, until results followed or the debtor was heard from, viz:

1ST LETTER

"This is just a little reminder that we have not received a check on your account, $....., but possibly you did not get our statement mailed out on the first, so we enclose another memo bill.

2ND LETTER

"Holy Smoke! Did you know that you had not sent us a check in whole or in part of your bill, $....., statement of which was sent you on the first?

"We know how easy it is to overlook these little things, so we are just sending you this to remind you again."

3RD LETTER

"Much as we'd like to go on a cash basis, people simply won't listen to it. They prefer to say, 'Charge It.' So we've got to do it.

"But with every charge account comes the painful duty of extracting checks painlessly. Please don't make this task any harder for us by not sending in your check, or writing us a letter telling us why you cannot pay, or when you can, or phone us, or 'sumpthin'."

4TH LETTER

"It seems a sad commentary on life that we should have to ask for payment of our bill, even at the risk of offending you. It is a sorry state of affairs, but your continued silence makes it necessary. What can you do to help us out of a bad predicament? Right away too!"

5TH LETTER

"Really now! This is the fifth letter, and we have no reply to the other four, nor a check—nor anything else! We are facing a situation on your account which is disturbing our peace of mind. Please don't make us lose patience with you! Send in your check by return mail!"

6TH LETTER

"We don't believe you intend to pay us. So the only thing left for us to do is to sue you, and this is the last or final notice. Not hearing from you by the ....., your account goes to our attorneys.

"We would not write you this last letter, but we are still hopeful that you will respond at the eleventh hour and save us all an unpleasant situation. But remember, the ..... is absolutely the deadline."

"And so the session ends. To some delinquent accounts almost the entire series has to be sent, but with others only a few of the letters are required to pry a check lose. Certain letters out of this series are picked to get the desired results. But known slow-pays get the whole works.

"The reason for using a series, or to send out one letter every week, is to exhaust every peaceful means of collecting an account and keeping the customer's good will and friendship at the same time. It is the persistent follow up which wins results. The debtor knows he has to do something about it.

"Each letter is so diplomatically worded as not to give offense, and, of course, in the long run very few accounts, comparatively speaking, need the entire dose of medicine to make them loosen up. The laxative effect comes quickly."

Thermit and Arc Welding to Be Demonstrated

A demonstration covering the thermit welding of rail-ends and also arc-welding procedure will be given by C. [illegible] Young, of the Metal & Thermit Corp., on Sept. 1 at the Welders' Information Center, 741 West 70th St., Chicago. The meeting and demonstration will be open to all persons interested in welding.

Welding Forum Planned for I. A. A. Convention

The evening of Nov. 18 is to be devoted to a forum on welding and cutting, during the annual convention of the International Acetylene Association to be held in St. Louis on Nov. 18 to 21. On the following evening will be held a series of round-table discussions on oxy-acetylene welding and cutting practices.

Every afternoon during the 3-day meeting, technical sessions will be held dealing with various aspects of oxyacetylene practices.

Berlin Congress to Consider Structural Welding

Papers and discussions on welded construction are included in the program of the Second Congress of the International Association for Bridge and Structural Engineering, to be held in Berlin, Germany, Oct. 1 to 8. The following topics, among others, have been announced: Influence of dynamic and frequently alternating loading on welded structures; design and execution of welds with special consideration of thermal stresses; inspection and control of welded joints; experience with completed structures; theory and research work on details of steel structures of welded and riveted construction. All publications of the Congress will be issued in separate English, French and German editions, and a special telephone system will enable participants to follow the discussions and speeches at the meetings in all three languages. Further information can be obtained from the Secretariat of the Association, Eidg. Techn. Hochschule, Zurich, Switzerland.

What's New in Equipment and Supplies

Improved Brazing Alloy Makes Leak-Proof Joints

Improvements and refinements in manufacturing Phos-Copper brazing alloy, which increase the field of application of this alloy, have been announced by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The new processes include annealing and pickling to insure freedom from any carbonaceous deposit on the surface which might interfere with the production of leak-proof joints. This makes the new alloy especially suitable for applications such as refrigerator parts where leak-proof joints are a necessity.

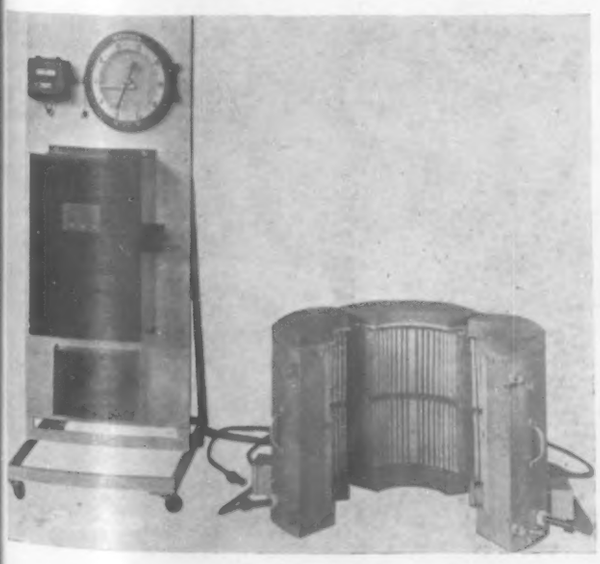
Three-Section Heater for Stress-Relieving Pipe

For local stress-relieving of welded pipe, a heater in three sections has been placed on the market by H. O. Swoboda, Inc., 4301 Main St., Pittsburgh, Pa., to supplement the concern's present line of "Falcon" heaters. The new heater is for pipe from 8 to 12 in. in diameter, with maximum wall thickness of 1¼ in. The heater has a capacity of 27 kw., and can be used on either 220 or 440 volts, 3 phase (one heater section per phase).

The three sections of the heater are clamped around the pipe joint, forming a complete circular unit. Regulating and controlling the temperature during stress-relieving and cooling is done automatically by means of a panel specially designed for the purpose. In addition to a contactor, transfer switch and push button, the panel also has a current-input regulator for regulating the heating-up and cooling-off periods for various thicknesses of pipes, and an automatic recording control pyrometer for recording and controlling the temperatures.

The heaters are provided with thermocouple location holes and with plug-type terminals. The control has 50 ft. of flexible cable with plugs for connecting to the heaters.

The heating face of the units is 22 in. long, thus insuring a uniform stress-relieving temperature in the pipe for a distance of six times the pipe-wall thickness on each side of the weld, and allowing the temperature of the pipe beyond this area to gradually diminish, thus avoiding any abrupt temperature differential between the hot and cold sections of the pipe.



Heater for Local Stress Relieving of Pipe Joints, With Panel for Automatic Control and Regulation of Temperature.

Regulator for Gas Delivery Pressures Up to 1,000 Lb.

A pressure regulator for delivery pressures between 0 and 1,000 lb. per sq. in. has been developed by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, in response to a demand from the oil industry, but which it is believed by the manufacturers may find some service in the welding field.

The regulator has two dials, one to show tank pressure, and the other to indicate working pressure, as is customary with devices of this type. It will accommodate any kind of gas, according to the makers.

New Dual-Control Transformer Welder

Special, built-in air ducts assure natural ventilation of the transformers of the new dual-control model a.c. arc welder recently placed on the market by the Eisler Engineering Co., 749 South 13th St., Newark, N. J.

New "Eisler" Transformer-Type Welder.

Temperature rise is said not to exceed 31° C., and the time of recovery from short circuit to 5% of normal not to exceed more than 2 cycles of the 60-cycle, single-phase current, conforming with NEMA standards.

The dual current control welder is said to give a finer regulation of current over the entire welding range. It permits the welding of light-gauge metal where the adjustment of the welding current is somewhat more critical.

Power consumption when the welder is not welding is 70 watts for the 200-ampere size and 100 watts for the 300-ampere size. Cost of operation of a 200-ampere stock welder is estimated by the maker at 9c an hour with a 3/16-in. electrode on a 3c kw.-hr. rate.

"Easyweld" Electrode for Transformer-Type Welders

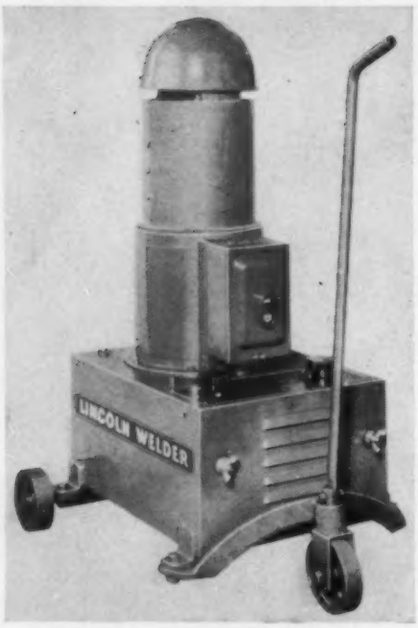
A new electrode, "Universal Easyweld," especially designed for transformer-type arc welders, is announced by the Universal Power Corp., 4300 Euclid Ave., Cleveland, O. With "Easyweld" it is claimed that the arc is very easily started and maintained. This electrode is especially recommended for repairs and maintenance work on steel or iron, and is ideal for light-gauge steel welding.

"Easyweld" electrodes are of the shielded-arc type, and produce weld metal of 55,000 to 65,000 lb. strength with a ductility of 15% to 20% elongation in 2 in.

Welder Permits Sustained Overloads Without Harm

A new motor-driven, single operator arc welder has been developed by The Lincoln Electric Co., Cleveland, Ohio. This machine, designated as the "SA-150," with a rated current range of 45 to 200 amperes. It can be used with either bare or shielded-arc electrodes.

It is claimed the utility of this new welder is broadened by the fact that at the proper points the machine is insulated with Class B insulation. Having



Welder Rated at 45-200 Amperes.

no inflammable materials, such as cotton, fiber, wood or bakelite, this insulation is insured against burn-outs, permitting sustained overloads without injurious effect. It is said that some shops are using it with electrodes as heavy as ¼ in.

This welder has dual control of voltage and current, allowing independent adjustment of arc heat and arc penetration to suit the welding application.

The "SA-150" is powered by a 7½-hp. a.c. motor, to operate from 60-cycle power circuits of 220 or 440 volts, three or two phase. Either portable or stationary models can be supplied. The net weight of the stationary model is 425 lb. The welder occupies a floor space of less than 2 ft. square.

Hard Copper Alloy for Welding Tips and Holders

One of the new copper alloys that will be especially interesting to manufacturers and users of welding equipment is being marketed under the name of Hackett K-Copper by its producers, the Hackett Brass Foundry, Detroit, Mich.

Hackett K-Copper is said to combine the physical properties of steel and bronze with the high electrical and heat conductivity of copper. Compared with pure copper, it has equal corrosion resistance, the same coefficient of expansion, coefficient of resistivity, and modulus of elasticity. It has a hardness of 70 to 80 Rockwell B (125 to 150 Brinell), ultimate strength of 70,000 lb. per sq. in., elongation of approximately 20%, reduction in area of 50%, and in drawn rod it has 83% the electrical conductivity of pure drawn copper, and in forged form it has 75% to 85% that of forged copper.

The alloy is available in bars, forgings and castings and is widely used for welding tips and holders. The producer uses it in the manufacture of a wide range of standard and special designs of spot-welding tips. The Hackett K-Copper tips are reported to mushroom less easily than pure copper, require dressing less frequently, and deliver a greater number of welds per tip.

Trade Literature

French "Laffitte" welding plates, welding powder and "Laffitte" tempering powder are described in some illustrated literature just issued by J. F. Hofmann, 422 Drexel Bldg., Philadelphia, Pa., sole distributor in the United States. The "Laffitte" welding plate can be used at low forge heat, it is claimed. Samples of any of these items will be supplied free if request is made on company letterhead.

"Carpenter" stainless-steel welded tubing is described in a new catalog published by The Carpenter Steel Co., 347 Madison Ave., New York, N. Y. Information is given on the manufacture of this tubing, forms in which it is available, pipe data, properties and heat-treatment working instructions, soldering, brazing and welding.

"The Story of Manganese Steel" is the title of a folder issued by the American Manganese Steel Co., Chicago Heights, Ill., describing the development of 10-14%-manganese steel, physical properties, manufacture, heat-treatment, machining, applications, and welding procedure.

Arc-welding accessories, including helmets, face shields, cover lens, goggles, protective clothing, scratch brushes, electrode holders, flexible cable, and cable lugs, are described in a new catalog published by the Universal Power Corp., 4300 Euclid Ave., Cleveland, O.

Arc-welded designs for a cam, an eccentric and a compound gear arm, each formed from tubing and bar stock, assembled by welding, are shown in Application Sheet No. 50 of Series 3, entitled "Machine Design," published by The Lincoln Electric Co., Cleveland, O.

"Sight Feed" acetylene generators are described, their economies are discussed, and many applications shown in Bulletin No. 36-G, recently published by The Sight Feed Generator Co., Richmond, Ind.

The new "Universal Easyweld" electrodes for a.c.-arc welders are listed and claims of performance made in a folder issued by the Universal Power Corp., 4300 Euclid Ave., Cleveland, O.

Hoisting equipment, including chain hoists, the "Pul-Lift," and trolleys, are described in a new booklet issued by The Yale & Towne Manufacturing Co., Philadelphia, Pa.

"Manco" phosphor-bronze electric welding rod is described and instructions for its uses given in a leaflet issued by the Eld Metal Co., Ltd., 1233 East 63rd St., Los Angeles, Calif.

Welded steel truck frames for multi-section cars built for the B. M. T. lines, are described in a booklet issued by Lukenweld, Inc., Coatesville, Pa.

Commercial News

Lincoln Obtains Rights for German Oxygen Machine

United States rights for a new type of machine for making oxygen has been obtained by The Lincoln Electric Co., Cleveland, O., from The Messer Co., Frankford-on-Main, Germany, according to an announcement from J. F. Lincoln, president of the Lincoln company, who recently returned from a business trip to Germany. It is expected that a demonstration plant will soon be installed in the works of a large user of oxygen near Cleveland. Mr. Lincoln is of the opinion that the new machine will be practicable not only for large users of the gas but also for many of the smaller users.

Cleveland and Buffalo to Have Welding Clinics

Latest developments in welding practise for non-ferrous alloys will be demonstrated at two clinics, to be held in Cleveland, O., and Buffalo, N. Y., during September. Included will be practical examples and demonstrations of the latest methods of electric and oxyacetylene

TOBIN BRONZE

Trade-Mark Reg. U. S. Pat. Off.

The original low melting point (1625°), bronze welding rod. Ideal for the oxy-acetylene welding of cast and malleable iron.

Also 15 other

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WELDING RODS

for Every Bronze Welding Purpose

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General Offices: Waterbury, Connecticut

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welding and brazing on monel, aluminum, nickel, copper, brass, bronze, Inconel, and nickel-clad steel.

The clinic at Cleveland will be conducted by welding engineers of The International Nickel Co., The Aluminum Co. of America, and the Revere Copper and Brass, Incorporated. It will be held in the warehouse of Williams & Company, Inc., 1748-56 East 22nd St., on Sept. 18 and 19.

At Buffalo, the clinic will be held on Sept. 25 and 26 in the warehouse of the Whitehead Metal Products Co. of New York, Inc., at 254 Court St. It will be under the auspices of The International Nickel Co., The Aluminum Co. of America, and The American Brass Co.

Somewhat similar clinics have been planned for Montreal and Toronto in October.

The Metals Coating Co. of America, 495 North 3rd St., Philadelphia, Pa., announces the following officers: president, James H. Gravell; vice-president and general manager, W. H. Ludington; vice-president, E. Waring Wilson; technical director, Dr. Leopold Pessel; and manager of sales promotion, Joe Magrath. The company is making arrangements to manufacture its own line of "MetaLayeRs" and expects to be in production by Sept. 1. Richard L. Binder, former president of the company, who passed away on March 20 last, spent 20 years in developing and promoting the "MetaLayeR" process. Mr. Ludington, who assumes the position of general manager, was formerly in charge of the Applied Engineering Department of the Air Reduction Sales Co., New York City.

Compressed Industrial Gases, Inc., through its subsidiary, the Wisconsin Oxygen-Hydrogen Co. of Kenosha, has established an office, warehouse and welding supply store in Milwaukee, at 167 N. Jackson St. The P. W. Heckel Oxygen & Hydrogen Co., who up to this time has been distributor in this territory for the Burdett Oxygen & Hydrogen Co. of Chicago, has been acquired by the Wisconsin Oxygen-Hydrogen Co., and Mr. Heckel joins the latter organization in a sales capacity. A. H. Seese is the Milwaukee representative for the Wisconsin Oxygen-Hydrogen Co., having recently been transferred from Chicago, where he is succeeded by B. J. Tesmer.

J. M. McKibbin has been appointed manager of a newly created sales promotion department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. All apparatus sales promotion operations, except those of the company's merchandising department, will be coordinated under the new department's management, and the activities of district office sales promotion managers will be directed by Mr. McKibbin. There will be no change in the advertising department, now under the management of R. R. Davis. Mr. McKibbin has been associated with Westinghouse in sales promotion work since 1920.

John E. Blankenbuehler was one of four employees who were signally honored on July 18 by Chairman A. W. Robertson and President F. A. Merrick, of the Westinghouse Electric & Manufacturing Co., when they were presented with the "Westinghouse Order of Merit" at a mass meeting of employees held in the East Pittsburgh works. Mr. Blankenbuehler received his award "for design and application engineering in connection with welding generators, for the energy and skill which enabled him to substantially improve their operation and appearance." Chairman Robertson made the award to Mr. Blankenbuehler.

The Bay City, Mich., plant of the Thompson-Gibb Electric Welding Co. is being opened this month after being closed for about four years. Approximately fifty men will be placed on its payroll. This plant will be operated as the welded products division of the company. H. B. Warren, formerly associated with the company at its Lynn, Mass., plant, will be in charge of operations. Welded assemblies made from stamping, for the automobile industry, will be manufactured.

The Welding Equipment & Supply Co., 2720 E. Grand Blvd., Detroit, Mich., have added to their organization Fred Weaver, as engineer, and C. P. Long, who becomes a member of the sales division. Mr. Weaver was formerly master mechanic of the Kercheval body plant of the Chrysler Corp., and Mr. Long was formerly with the Pratt-Stribling Co., of Ann Arbor, Mich.

To meet an increased demand for governors for industrial gas and Diesel engines, the Pierce Governor Co., Anderson, Ind., have added 7,000 sq. ft. to their factory production department, and an increase of 20% to their toolroom capacity, also three new rooms to the office, according to D. J. Noland, sales manager.

The New York office of the Marquette Manufacturing Co. has been moved from Brooklyn to 119 West 63rd St., New York City. A sales organization of thirteen men operates from this office, covering New York state, eastern Pennsylvania, and part of Connecticut.

The Lincoln Electric Co., Cleveland, O., has appointed the Industrial Supply Co. as distributor at Salt Lake City, Utah, and the Intermountain Belting & Packing Co., 1414 Wazee St., Denver, Colo., as its agent, covering the state of Colorado and part of Kansas, Nebraska and Wyoming.

Frank J. Nageldinger, president of John Nageldinger & Son, Inc., New York, N. Y., died on June 25 following a long illness. He was 58 years old. The business will continue under the same name, with Herbert Wittman, a nephew, and Morris Moskowitz as executive officers.

The Trex Engineering & Supply Co. have enlarged their new quarters in a three-story building at 611 McCarter Highway, near Mulberry Place, Newark, N. J. Joseph Weiss, formerly eighteen years with the International Oxygen Co., has joined the organization.

Owing to their greatly expanding business, the T. W. Smith Co., Inc., have moved into larger and better-appointed quarters at 843 Tenth Ave., New York, N. Y. Their former address was 245 West 54th St.

The San Francisco, Calif., office of The Lincoln Electric Co. has been moved from 894 Folsom St. to 866 Folsom St., where 50% more space is being used than in the old location. L. P. Henderson is manager.

A paper on "Welding Wire" will be given by Robert Notvest, welding engineer, J. D. Adams Co., Indianapolis, Ind., at the meeting of the Wire Association to be held in Cleveland, Oct. 19 to 23.

Robert S. Murray, former treasurer of the General Electric Co., died July 25 after a year's illness. He was 68 years of age, and retired from his position with General Electric on May 1 of this year.

H. R. Faulk, 50 Penn Ave., Pittsburgh, Pa., has been appointed distributor, in the Pittsburgh district, for Roth Welding Engineering Co., Inc., Detroit, Mich., and the Electroloy Co., Inc., New York, N. Y.

R. D. Thomas & Co., 401 North Broad St., Philadelphia, Pa., have issued a new folder on arc-welding accessories, including electrode holders, welding helmets and handshields, and welding cable.

The Hobart Arc Welder Sales and Service in Detroit has been moved from the location at John R St. and E. Milwaukeee Ave. to 1019 Holden Ave., about three-quarters of a mile west.

The Sight Feed Generator Co., Richmond, Ind., has been appointed distributors of welding and cutting equipment made by the Victor Welding Equipment Co., of San Francisco, Calif.

The Tiger Flux Sales Co. has been organized in Detroit, Mich., by George F. Coon, Detroit automobile dealer, to distribute a new welding flux, known as "Tiger" flux.

The Wisconsin Oxygen-Hydrogen Co., 167 N. Jackson St., Milwaukee, Wis., has been appointed dealer in eastern Wisconsin for the Westinghouse line of arc welders.

The Middlesex Welding Supply Co., Inc., 255 George St., New Brunswick, N. J., have opened a branch office in the Schultz Building, Asbury Ave., Asbury, N. J.

The Smith Welding Equipment Eastern Corp. has moved its Pittsburgh, Pa., office to the Flannery Building. L. J. Upperman is district manager.

Notes From the Field

The Cleveland Welding Co. is cutting its notch in the bicycle business. Last December, this concern, looking for a new line to bridge a production gap, turned to the manufacture of bicycles, a venture it had never tried before. In eight months the company has been turning out bicycles, employment has doubled at the plant, from 400 to 800. The demand has been so great on "bike" manufacturers all over the country that even this concern, the infant in the trade, is two months behind in orders. Alvin F. Mellman, secretary-treasurer of the company, will not reveal daily production figures, but admits that an estimate of 750 a day "is a little low." The plant is reported to have orders for 40,000 bicycles stacked on the waiting file.

The Truscon Steel Co., of Youngstown, O., and the American Steel & Wire Co. of Pittsburgh, Pa., are working on a joint contract to furnish 4,500,000 sq. ft. of welded wire fabric for bank revetment work in the Second New Orleans District, lower Mississippi river. U. S. Army Engineers' offices at Pittsburgh have been asked to make inspection of this huge order of wire material. The Truscon Steel Co. will begin work at once to furnish 90,000 twist wires and 20,000 end twist wires for use on revetment work on the Mississippi river in the Memphis district.

Many remarkable and original ideas are shown in the plans for trailer frames brought to The Superior Welding Co., 331 Knoxville, Peoria, Ill., by customers who find it more reasonable to have these trailer frames built and then finish building the trailers themselves, than it is to buy a factory-made trailer. It is surprising the various ideas that are shown for making hitches, building the trailers for ballast and the number of safety devices that are developed. This company has welded several of these frames recently.

The last of 10 all-welded steel barges has just been delivered by the Treadwell Construction Co., of Midland, Pa., to the Pittsburgh Coal Co. for use in inland-waterway service in the tri-state district of western Pennsylvania, eastern Ohio and northern West Virginia, according to Bayard W. Hunsicker, vice-president and treasurer of the Treadwell organization. The barges, which are 175 ft. long, 26 ft. wide and 10 ft. 8 in. deep, each have a capacity of 1,000 tons. They will make valuable additional equipment to the Pittsburgh Coal Co.'s already large river facilities.

The Bethlehem Steel Co. has just completed the first of two large welded tanks which are being erected for the Patterson Oil Terminal, Inc., of Paulsboro, N. J., as a storage for domestic heating oil. This all-welded tank is 120 ft. in diameter, 40 ft. high, and has a capacity of 80,000 barrels. The bottom and roof of this enormous tank were lap-welded, while the shell was butt-welded. The tank was erected in approximately five and one-half weeks and required 267 tons of steel.

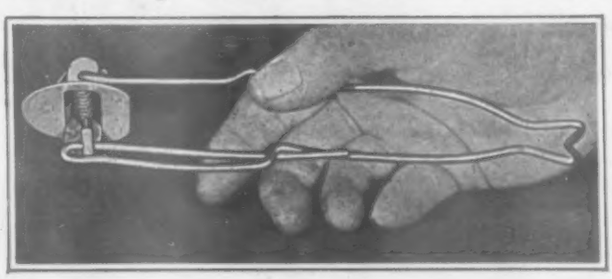
The International Petroleum Co., Ltd., Toronto, Ontario, are taking bids on six oil tank barges, according to information received in barge-building circles at Pittsburgh, Pa. Three of these will have a capacity of 180,000 gallons each and will be 150 ft. long, 30 ft. wide and 7 ft. deep, while the other three will be 125 ft. long, 30 ft. wide and 7 ft. deep, with a capacity of 150,000 gallons each. The barges will be used for the transportation of oil products on inland waterways.

The H. B. Wilson Manufacturing Co., Athens, Ill., as a method of advertising, have built a midget automobile painted a bright orange and displaying the Allis-Chalmers name on one side and the firm name on the other. It has a one cylinder engine mounted on the rear of the machine and will develop a speed of about ten miles per hour. It will be on display during the Illinois State Fair, where it will be available to any child who wishes to drive it.

Construction of a 47-mile extension to Silver City, N. M., of the El Paso-Douglas (Ariz.) natural-gas line, owned by the El Paso Natural Gas Co., has just started. The line, which will intersect the main trunk line at Gage, N. M., is 5 in. in diameter, and all-welded.

The Marietta Manufacturing Co., of Point Pleasant, W. Va., recently launched the last of four all-welded tank barges from its marine ways in the Ohio

The Improved "Round File" Gas Lighter



Many superior design and construction features, found only in Improved "Round File," make this lighter the Welder's Favorite.

Hood forms a pocket for gas, insuring immediate ignition.
Larger file area, providing longer life for lighter.
Larger spark metal, which assures many additional ignitions.
Locking slip-on renewal cartridge, permits immediate replacement.
Cadmium plated, preventing rust.
Every part **thoroughly tested.**
Fully guaranteed.

Write for descriptive circulars and prices.

CAUTION: Imitations of the patented Improved "Round File" are on the market. For your protection insist on Safety Gas Lighter Co. patented lighters and genuine Safety Gas Lighter Co. renewals.

ORIGINATORS OF THE HAND GAS LIGHTERS **SAFETY GAS LIGHTER CO.** Est. 1901 **LYNN, MASS.**

River. They are being built for the Standard Oil Co. of New Jersey, according to C. O. Weisenberger, president of Marietta. The barges are 175 ft. long, 35 ft. wide and 8.6 ft. deep. They will be used for the transportation of petroleum products in the river trade.

Frank A. Longo, welding foreman in the machine shops of the Southern Pacific Railway, Los Angeles, Calif., has been sent by his company to the Lima (O.) Locomotive Works to inspect the construction of six streamlined steam locomotives. Mr. Longo is a past chairman of the Los Angeles section of the American Welding Society, and is just completing his 24th year with the Southern Pacific Railway.

An order for six large welded cracking vessels was received Aug. 6 by the A. O. Smith Corp. The equipment will be used by the Shell Petroleum Corp. in a combination crude-oil and cracking unit adjoining Shell's plant at Houston, Texas. The new unit will have a capacity for running 16,000 barrels of crude a day and will require nine to ten months to complete, at an estimated expenditure of $1,500,000.

The Gulf Oil Refining Co. of Pittsburgh is in the market for four oil barges for use in the movement of Petroleum products on the Ohio and Mississippi Rivers. Specifications are being taken on both riveted and welded equipment. The barges are to be 150 ft. long, 35 ft. wide and 10 ft. deep. The company is also taking alternate bids on four barges 190 ft. long, 35 ft. wide and 10 ft. deep.

Continuing its fleet modernization program, the Pittsburgh Coal Co. recently launched the *Ranger*, its newest vessel, at the Neville Island marine ways of the builder, the Dravo Contracting Co., of Pittsburgh, Pa. The new boat is the first specially designed all-metal arc-welded stern wheeler to be used on Western rivers, where it will transport coal to large mill users at down-river points.

The monthly meeting of the Greater Cincinnati Welders Association was held on the evening of Aug. 5 at its headquarters, 1429 Elm St., Cincinnati, Ohio. A general talk on oxyacetylene was made by George Inks, of Gas Products, Columbus, Ohio. M. E. Michels of the R. Michels Welding & Supply Co., Covington, Ky., president of the welders organization, presided.

The Edward G. Budd Manufacturing Co., Philadelphia, Pa., announces that it is working on 41 light-weight, welded stainless-steel railroad passenger cars, for which it has received orders since the first of the year, and has commitments for 40 additional cars. Foreign licensees are building 40 cars in France and 20 in Italy, and 10 cars recently were completed in Italy.

The Standard Oil Co. of Louisiana, with headquarters at New Orleans, is taking bids on two all-welded oil tank barges. These will be 175 ft. long, 35 ft. wide and 8 ft. deep, and will supplement the company's present fleet used in the movement of petroleum products on inland waterways.

RYERSON *a dependable source for* **WELDING ROD**

Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types including both electric and gas rods are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment.

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ELECTRODES

Ryerson Shielded Arc Type No. 215
Ryerson Shielded Arc Type No. 216
Ryerson Shielded Arc Type No. 217
Ryerson Green Processed No. 18
Ryerson Green Processed No. 6
Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blue Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Ryerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

JOSEPH T. RYERSON & SON, INC.

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The State Metal School, now located in larger quarters at 481 Ellicott St., Buffalo, N. Y., are offering courses of instruction in acetylene welding, electric welding, and metal finishing. Special instruction is given in aircraft welding in connection with the acetylene-welding course and combination arc-and-acetylene-welding course.

Two technical motion pictures, showing the welding of an all-steel automobile body and the manufacture of an automobile crankshaft, were shown at The Caterpillar Tractor Co. on Aug. 10 by the Peoria Chapter of the American Society of Metals. The films were furnished by the U. S. Department of the Interior.

The Harrisburg Machine & Electric Welding Co. has just finished a month and a half of work on the new air-conditioning system being installed in the F. W. Woolworth five-and-ten-cent store on Market Street in Harrisburg. They received the sub-contract from the York Ice & Machine Co. for the welding of the pipes and the making of the brackets.

C. W. Bryan, Jr., has been appointed vice-president in charge of sales for the Federal Shipbuilding & Dry Dock Co., Kearny, N. J., with headquarters at 25 Broadway, New York, N. Y. Mr. Bryan, long active in welding circles, was recently elected chairman of the New York Section of the American Welding Society.

A. C. Cummins, general superintendent of the Duquesne Works of the Carnegie-Illinois Steel Corp., was appointed assistant manager of operations, Pittsburgh district, effective August 1. K. H. McLaurin, chief mechanical engineer, will succeed Mr. Cummins.

The Covington Welding Co., Covington, Ky., recently repaired three cracked motor blocks which were damaged in last winter's sub-zero weather, the repair work being done during the hottest weather Covington has ever experienced.

Welders in and near Peoria, Ill., regret the passing of one of their number, Roy Billedeaux, who was drowned recently while swimming. He was an operator at Hiram Walker's distillery.

The death of Alfred M. Wood, general superintendent of Teleweld, Inc., Chicago, Ill., occurred on the night of Aug. 10, caused by a heart attack. He was 46 years of age.

Wm. Dolacek and Lewis Hughes have opened a new welding shop at Chase, Kan. They are specializing in oilfield welding.